The Italian landrace conservation strategy

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Index

1. Premise

Currently, landrace diversity is threatened in all European countries (as well as in the entire world) and in need to be preserved both *in situ* and *ex situ*. Those countries which are signatories of both the Convention on Biological Diversity and the International Treaty have an obligation and responsibility for landrace conservation.

The EC FPVII 'PGR Secure project' (http://www.pgrsecure.org/) aimed at developing conservation strategies for European crop wild relative and landrace 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 the University of Perugia, Italy, as WP4 leader, focused on developing tools and strategies for the European and Italian landrace conservation.

The Italian strategy for landrace conservation was worked out as recommendations for actions to be taken in the next future by considering the present constrains to conservation, as they emerged from the data gathered during PGR Secure and from the exam of the international and national context and of the available literature.

Thanks are due to all the Italian Regions and Autonomous Provinces that, kindly providing data about the landrace that are still maintained *in situ* (on-farm) on their territory, made it possible this study.

We hope that the strategy will serve to further develop the present conservation actions towards an effective and efficient *in situ* (on-farm) and *ex situ* conservation in Italy.

2. Introduction[1]

In Italy, as in most of the countries of Europe, a rapid decline of agro-biodiversity, i.e. the diversity of living organisms (plants, animals, bacteria, etc.) used in agriculture (Wood and Lenné 1999), is taking place (Bertacchini 2009). As far as the diversity of cultivated plants is concerned the decline is due mainly to a series of economic and institutional factors which have encouraged the spread of varieties that maximise productive efficiency on vast farming areas. These varieties ensure high profit margins for the large seed companies that promoted their use. Traditional crop varieties, generally known as 'landraces' (LR), but also called 'farmer varieties,' 'local varieties,' or 'primitive varieties were rapidly and widely substituted by modern varieties in the past. However they have been continuously maintained by people within their local biological, cultural and socio-economic context (Negri *et al.* 2009; Veteläinen *et al.* 2009a, 2009b, 2012) and are an important fraction of agro-biodiversity.

2.1. Landrace Definition and Importance

It is not easy to define what a LR is. Recently the following categorization was proposed (see also Negri *et al.* 2013; 2014):

i) *sensu stricto* landraces (LR), including all the elements variously put in evidence by several definitions and Authors, *sensu stricto*, a LR should be defined as a 'variable population, which is identifiable and usually has a local name, (generally) lacks formal crop improvement, is characterized by a specific adaptation to the environmental conditions of the cultivation area (tolerant to the biotic and abiotic stresses of that area) and is closely associated with the uses, knowledge, habits, dialects and celebrations of the people who have developed and continue to grow it (Negri *et al.* 2009; Polegri and Negri 2010). They are structured populations made up of several subpopulations. Also for clonally-propagated crops (e.g. vines, olive trees and other crops) LR are often constituted of multiple genotypes (Cipriani *et al.* 2002; Fornek *et al.* 2003).

In short, they are extant LR, which have continuously maintained their link with the territory of adaptation. *Sensu stricto* LR are often under threat of extinction and thus deserve the highest attention.

ii) Re-introduced LR, are *sensu stricto* LR that were once cultivated in a certain area and have been reintroduced in cultivation (from genebanks) in the same area of previous cultivation after a certain period of time.

iii) Introduced LR, are LR that originated in an area different from that where they are presently grown.

LR are important components of Plant Genetic Resources for Food And Agriculture (PGRFA).

As Esquinas-Alcazar (1993) writes "The heterogeneous varieties of the past have been and still are the plant breeder's raw material. They have been a fruitful, sometimes the sole, source of genes for pest and disease resistance, adaptation to difficult environments, and other agricultural traits like the dwarf-type in grains

[1] This section is largely taken from "The ECPGR concept for in situ (on-farm) conservation in Europe" (Negri et al., 2014)

that have contributed to the green revolution in many parts of the world". This is particularly important in a period of climate changes and unpredictability.

In addition, when they are maintained *in situ* (on-farm) they allow to (Negri *et al.* 2014):

- maintain and develop diversity for local communities and breeding (including participatory plant breeding), as a pre-requisite to ensure food security, productivity as well as resilience to biotic and abiotic stresses in a scenario of climate change and unpredictability,
- develop new (e.g. environmentally friendly) farming systems that are based on 'diverse' varieties and answer the needs of farmers (like organic farmers) and the consumer demand for a sustainable production systems,
- develop farming systems that rely on LR to produce high value typical products
- maintain and develop different traditions and uses of a crop while extending crop and varietal uses,
- maintain viable agro-ecosystems and useful agro-ecosystem services,
- increase farmer capacities that are related to selection and conservation methods, improving yield and quality.

Due to the modernization of agriculture and breeding for uniformity (Negri 2005; Negri *et al.* 2009) the loss of LR has been, and continues to be, extensive and therefore there is a pressing need to actively conserve extant LR *ex situ* and *in situ*.

2.2. Landrace Conservation *In Situ* and *Ex Situ*

2.2.3. On-farm conservation definition

In the most relevant documents (see also section 3) that bind signatory countries to a proper conservation of Plant Genetic Resources (PGR), i.e. the Convention on Biological Diversity (CBD 1992, Definition Article 2: Use of Terms) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (FAO 2001, Article 2: Use of Terms), the following definition for *in situ* conservation can be found:

> "*In-situ* conservation *means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties"*.

We can eventually note that, similarly,

- The Commission Directives 2008/62/EC 20 June 2008 and 2009/145/EC 26 November 2009 states: "*conservation in situ means the conservation of genetic material in its natural surroundings and, in the case of cultivated plant species, in the farmed environment where they have developed their distinctive properties"*.

No specific mention to the term 'on-farm' conservation is given in these documents, although it should be acknowledged that, with specific reference to cultivated taxa, the term 'on-farm conservation' came into use.

Considering the principal need to refer to the above mentioned documents, by virtue of their binding nature, we will

- maintain the exact meaning of '*in situ conservation*' that is given by the CBD and the ITPGRFA and consequently define "on-farm conservation" as the ''*conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of domesticated or cultivated species in the surroundings where they have developed their distinctive properties*''
- refer about *in situ* (on-farm) conservation in this document. The term '*in situ* (on-farm)' will be used for conservation activities that are carried out on-farm, but also in home and community gardens. All the same the term 'farmer/s' is meant to include 'gardener/s'.

2.2.3 *In situ* (on-farm) conservation focus

In the context of the definition given above, and taking into account available bibliography on the matter (Maxted *et al.* 2002; Negri 2003, 2005), there are two possible focuses for *in situ* (on-farm) conservation Negri *et al.* 2014):

- on a certain cultivated Plant Genetic Resource (PGR) population/clone *per se* and
- on a certain agro-ecosystem where a/several population/s is/are cultivated, i.e. a holistic approach

At present, *in situ* (on-farm) conservation is in most cases oriented to conserve *sensu stricto* LR or introduce or reintroduce LR into cultivation (from genebanks), although in some cases, especially in the North of Europe, it is oriented to develop Broad Genetic Base Varieties. These are varieties purposely developed by farmers/farmer organisations (and in some cases by breeders), from different initial materials (LR by LR or cultivar crosses, wide crossings among cultivars, etc.) and obtained with different breeding practices (often by Participatory Plant Breeding) that are continuously maintained on-farm.

Nevertheless, the CBD and ITPGRFA, that we used to define on-farm conservation [and also the definitions given by European Union (EU) Directives on the commercialization of 'conservation variety' seeds] implicitly suggest a comprehensive approach that takes into consideration all the biotic and abiotic components of a certain agro-ecosystem, i.e. a holistic approach to conservation (see section 3).

In addition, the CBD definition of *in situ* (on-farm) conservation implies that a certain genetic resource is maintained in its environment of adaptation, i.e. within the abiotic and biotic context where it evolved its distinctive characteristics. Then, this should be the true perspective to look at *in situ* (on-farm) conservation. However, the topic has been largely neglected up to now.

Beside the presence of intraspecific diversity (i.e. different varieties and variable materials of the same crop), the diversity of other living beings (i.e. interspecific diversity) and of the agro-ecosystems should all be considered in a 'holistic' approach.

The areas that are richest in the above mentioned components should be considered the Most Appropriate Areas (MAPAs) where to set or enhance *in situ* (on-farm) conservation activities. Among them, those areas where other important and threatened genetic resources (like Crop Wild Relatives, CWR) are present appear to deserve the highest attention and priority.

It has to be noted that agriculture is a process that indeed belongs to nature, also when it takes advantage of resources that have been developed by mankind (as LR), since mankind is part of nature; as a

consequence, there is no substantial reason why the dichotomy between natural world and mankind world (including agriculture) should be maintained. On the other hand, agriculture does take advantage of wild species that are components of agro-ecosystems (e.g. nitrogen fixing wild legumes or wild pollinators) and, in some cases, is based on wild species (e.g. natural grasslands).

Negri *et al.* (2012) considered as MAPAs the areas where different LR of different crops, different types of agro-ecosystems, high number of protected areas and of CWR species, have the highest concentration.

The concept of MAPAs develops that of 'High Nature Value Farmland' (HNVF), initially proposed by Baldock *et al.* (1993) and Beaufoy *et al.* (1994), and defined at the EU level (SEC(2011) 540 Final) as ''farmland/forested areas characterised by high biodiversity''. They can be possibly used as LR reintroduction or introduction areas.

The introduction of this concept appears to be fully justified also taking into account the following relevant documents.

The 2nd Global Plan of Action (2nd GPA, FAO 2011) recommends that "agricultural biodiversity and biodiversity more generally are not addressed as separate entities", underlines that ''ecosystems contain important PGRFA, including rare, endemic and threatened CWR and wild food plants'' and suggests to ''include, as appropriate, among the purposes and priorities of national parks and protected areas, the conservation of PGRFA, in particular appropriate forage species, CWR and species gathered for food or feed in the wild, including in their biodiversity hotspots and genetic reserves'' and to '' consider integrating the conservation and management of PGRFA, particularly CWR and wild food plants, in land-use plans in their centres of origin, centres of diversity and biodiversity hotspots''.

The EU 2020 Biodiversity Strategy (the European Parliament Resolution, 2012) first target is: "Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss"; the second is the 2050 vision: "By 2050, EU biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided." It also "calls for a strengthening of Pillar II [of the Common Agricultural Policy, CAP] and for drastic improvements in all Member States to the environmental focus of that pillar and to the effectiveness of its agro-environmental measures, including … support for High Nature Value and organic farming…"

On the other hand, ''Maintain and restore ecosystems and their services'', ''Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity'', ''Halting biodiversity loss'' were clear targets (T2, T3, T6, respectively) in the Accompanying the document communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions. our life insurance, our natural capital: an EU biodiversity strategy to 2020'' (SEC(2011) 540 Final).

2.2.4. *Ex situ* conservation definition and focus

The CBD (CBD 1992, Definition Article 2: Use of Terms) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA 2001, Article 2: Use of Terms) stated:

> "*Ex-situ conservation*" means *the conservation of components of biological diversity outside their natural habitats"*.

By definition *ex situ* conservation focuses on a single genetic resource. *Ex situ* conservation is carried out in seed repositories, in vitro collections or living collections (as arboreta or plant collections) at public (genebanks, botanical gardens) and private institutions (plant breeding companies, farmer networks).

2.2.5. *In situ* vs *ex situ* conservation and complementarity

There is an obvious fundamental difference between these two strategies: *ex situ* conservation involves the sampling, transfer and storage of a population of a certain species away from the original location where it was found whereas *in situ* conservation involves the designation, management and monitoring of the population at the location where it is currently found and within the community to which it belongs.

The primary characteristic of *in situ* (on-farm) conservation is its dynamic nature in contrast with *ex situ* conservation which is mainly static. In addition, *ex situ* conservation is generally focused on a single genetic resource, while a complex of populations can be preserved and evolutionary processes can continue through *in situ* (on-farm) conservation. Provided their genetic diversity is wide, i*n situ* (on-farm) populations continue to evolve in response to biotic and abiotic pressures and to adapt to their environment. They are, therefore, an always updated source of genes for crop improvement, particularly of crops that are growing in adverse environmental conditions resulting from climate change (see for example Negri and Tiranti 2010; Nevo *et al.* 2012; and references therein).

Article 9 of the CBD (1992) stresses that the two conservation strategies should not be viewed as alternatives or in opposition to one another but rather should be practiced as complementary approaches to conservation, each providing a safety backup for the other. The goal of applying the two conservation strategy is ultimately to serve the present needs of plant breeders on one side and the need to maintain genetic resources always tuned with environment for future unpredictable changes on the other side.

3. The International Context

Twenty years after the landmark 1992 Earth Summit in Rio and the CBD (1992), the Rio+20 declaration on "The future we want" reaffirmed the need to improve food security, based on sustainable agricultural practices that preserve natural resources, including genetic diversity, by building on enhanced agricultural research and stronger international cooperation.
During the past 15 years, there have been major policy developments with impact on the conservation, use and exchange of PGRFA. Undoubtedly, the most important ones have been the ITPGRFA (FAO 2001), which entered into force in 2004, and the 2nd GPA (FAO 2011), both reflect a wide consensus among states and have a binding nature for many European states and the European Union (EU).

The ITPGRFA, through its Multilateral System, facilitates access to PGRFA and allows the fair and equitable sharing of benefits arising from their use. It was negotiated by FAO Commission on Genetic Resources for Food and Agriculture in the context of the Nagoya Protocol, and engages parties to conserve plant agricultural biodiversity both inside (including on-farm) and outside ecosystems and natural habitats and to

sustainably use genetic resources. The Parties agree to engage in measures covering agriculture, research and breeding and to facilitate access to plant genetic resources. The Treaty recognises the role and rights of farmers in conserving, using and improving agricultural genetic resources and sharing the related benefits.

In particular the ITPGRFA (art. 5) calls each Contracting Party, subject to national legislation, and in cooperation with other Contracting Parties, where appropriate,

- 1. "to promote an integrated approach to the exploration, conservation and sustainable use of plant genetic resources for food and agriculture and in particular, as appropriate:"

a) "Survey and inventory plant genetic resources for food and agriculture, taking into account the status and degree of variation in existing populations, including those that are of potential use and, as feasible, assess any threats to them;"
b) "Promote the collection of plant genetic resources for food and agriculture and relevant associated information on those plant genetic resources that are under threat or are of potential use;"
c) "Promote or support, as appropriate, farmers and local communities' efforts to manage and conserve on-farm their plant genetic resources for food and agriculture;"
d) "Promote *in situ* conservation of wild crop relatives and wild plants for food production, including in protected areas, by supporting, inter alia, the efforts of indigenous and local communities;"
e) "Cooperate to promote the development of an efficient and sustainable system of *ex situ* conservation, giving due attention to the need for adequate documentation, characterization, regeneration and evaluation, and promote the development and transfer of appropriate technologies for this purpose with a view to improving the sustainable use of plant genetic resources for food and agriculture;"
f) "Monitor the maintenance of the viability, degree of variation, and the genetic integrity of collections of plant genetic resources for food and agriculture."
g) "Take steps to minimize or, if possible, eliminate threats to plant genetic resources for food and agriculture".

Article 6 of the Treaty also calls each Contracting Party

- 2. "to promote the sustainable use of PGRFA with measure such as:"

a) "pursuing fair agricultural policies that promote, as appropriate, the development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources;"
b) "strengthening research which enhances and conserves biological diversity by maximizing intra- and inter-specific variation for the benefit of farmers, especially those who generate and use their own varieties and apply ecological principles in maintaining soil fertility and in combating diseases, weeds and pests;"
c) "promoting, as appropriate, plant breeding efforts which, with the participation of farmers, particularly in developing countries, strengthen the capacity to develop varieties particularly adapted to social, economic and ecological conditions, including in marginal areas;"
d) "broadening the genetic base of crops and increasing the range of genetic diversity available to farmers;"
e) "promoting, as appropriate, the expanded use of local and locally adapted crops, varieties and underutilized species;"
f) "supporting, as appropriate, the wider use of diversity of varieties and species in on-farm management, conservation and sustainable use of crops and creating strong links to plant breeding

and agricultural development in order to reduce crop vulnerability and genetic erosion, and promote increased world food production compatible with sustainable development;" and

g) "reviewing, and, as appropriate, adjusting breeding strategies and regulations concerning variety release and seed distribution."

The 2nd GPA for Plant Genetic Resources for Food and Agriculture (FAO 2011), prepared under the aegis of the Commission on Genetic Resources for Food and Agriculture, updates the GPA 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 GPA 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 CBD 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.

In particular, the 2nd GPA (FAO 2011) calls for

- 1. "Surveying and inventorying PGRFA". It is obvious that an inventory is the needed informative basis for any integrated *ex situ* and *in situ* (on-farm) conservation action (Box 1);
- 2. "Supporting on-farm management and improvement of plant genetic resources for food and agriculture;"
- 3. "Assisting farmers in disaster situations to restore crop systems;"
- 4. "Promoting *in situ* conservation and management of crop wild relatives and wild food plants;"
- 5. "Supporting targeted collecting of PGRFA;"
- 6. "Sustaining and expanding *ex situ* conservation of germplasm;"
- 7. "Regenerating and multiplying *ex situ* accessions;"
- 8. "Expanding characterization, evaluation and further development of specific subsets of collections to facilitate use;"
- 9. "Supporting plant breeding, genetic enhancement and base-broadening efforts;"
- 10. "Promoting diversification of crop production and broadening crop diversity for sustainable agriculture;"
- 11. "Promoting development and commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species;"
- 12. "Supporting seed production and distribution;"
- 13. "Building and strengthening national programmes;"
- 14. "Promoting and strengthening networks for PGRFA;"
- 15. "Constructing and strengthening comprehensive information systems for PGRFA;"
- 16. "Developing and strengthening systems for monitoring and safeguarding genetic diversity and minimizing genetic erosion of PGRFA;"
- 17. "Building and strengthening human capacity;"
- 18. "Promoting and strengthening public awareness on the importance of PGRFA."

As a party to CBD, 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. The Strategy is also the European Union's means of implementing the CBD Strategic Plan for Biodiversity into EU policies and actions, a 'National Biodiversity Strategy and Action Plan' (NBSAP) in the CBD terminology. 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 Target 3 of the EU biodiversity strategy calls for "increasing the contribution of agriculture and forestry to maintaining and enhancing biodiversity" and Target 6 for "helping avert global biodiversity loss".

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 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 June 2013 reform of the CAP is focused on three priorities: i) viable food production, ii) sustainable management of natural resources iii) balanced development of rural areas throughout the EU.

It specifically mentions measures to "help farming meet the challenges of soil and water quality, biodiversity and climate change. It also specifically mentions the need to favour crop diversification, and conserving areas of ecological interest".

For the Rural Development it foresees, among its six priorities," restoring, preserving and enhancing ecosystems and the possibility for the Member States / regions to design thematic sub-programmes to pay especially detailed attention to [among others] the climate change mitigation / adaptation and biodiversity issues".

The European Commission Report To The European Parliament, The Council And The European Economic And Social Committee (2013) about Agricultural Genetic Resources 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 on-going development of relevant policies and programmes, notably:

- the Rural Development Policy, via its agro-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 and Innovation Policy with its Framework Programme Horizon 2020 to build up the knowledge base on genetic diversity in agriculture".

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.

Specifically regarding LR on-farm conservation, a main constrain is the lack of LR seed on the market. Up to 2008, European seed regulation made impossible to commercialise LR seed because the registration into the European Common Catalogue of varieties requires, beside distinctness and stability, uniformity, a trait that LR do not have. As a consequence, farmers obtained LR seed through informal exchanges.
However, the Commission Directives 2008/62/EC 20 June 2008 and 2009/145/EC 26 November 2009, that are aimed "to ensure *in situ* conservation and the sustainable use of PGR", as their premise states, allowed for derogations on seed production and marketing of LR seed and opened a new way for their conservation (Spataro and Negri 2013). Following these directives LR can be registered into Common Catalogue of varieties as 'conservation varieties' and their seed commercialised, although with certain restrictions.
The sale of conservation variety seed is allowed provided that (among others):

- •it is limited in quantity,
- •it is restricted to the 'region of origin' (i.e. the region(s) in which the variety has historically been grown, and to which it is naturally adapted),
- •the conservation variety is under threat, and
- •the conservation variety is listed in the relative section of the European Variety Catalogue.

Box 1. An inventory is the needed informative basis for promoting any integrated *ex situ* and *in situ* (on-farm) conservation action. Specifically concerning LR maintained *in situ* (on farm) an inventory assures the possibility of (adapted from Negri *et al.* 2014):

- promoting the use variable materials in agriculture in such also achieving their *in situ* (on-farm) conservation. This can be done by enhancing economic and cultural motivations to maintain them, for example:
  - enhancing the value of LR products by the use of mark labelling (i.e. Protected Designation of Origin, Geographic Designation of Origin, Traditional Specialty, certified product from Organic Agriculture, etc.),
  - developing of local food supply systems based on LR, (i.e. campaigns that promote the commercialization of food from 'nearby' farms in local markets, grouping consumers for obtaining reductions to the prices, offering agri-touristic services, serving local food in restaurants),
  - enhancing the use of LR in environmentally and economically sustainable farming systems, which presently answer the needs of farmers (like organic farmers) and the consumer demand for a sustainable production systems,
  - developing food chains based on LR,
  - enhancing the use of LR in community and home gardens,
  - enhancing the cultural anchorage of a certain community to the LR it developed,
- collecting materials not already present in *ex situ* collections,
- promoting the use of LR in breeding and participatory breeding by exploiting their genetic diversity,
- promoting research on LR for
  - within- and among- genetic diversity level, for traits conferring
    - resistance/tolerance to biotic stresses
    - resistance/tolerance to abiotic stresses
    - quality,
  - *in situ* (on-farm) genetic diversity evolution under changed climatic conditions,
  - level of genetic diversity that can be maintained under
    - different agro-ecosystems,
    - different management systems (e.g. environmental friendly agronomic systems vs 'conventional' agronomic systems),
- developing the research needed to identify agro-biodiversity hot spots (MAPAs) and compile their inventory.

The development of the inventory also

- answers the 2nd GPA (FAO 2011), the ITPGRFA (FAO 2001, to which Italy, as many European countries and the EU are signatory) and the EU 2020 Biodiversity Strategy (the European Parliament Resolution, 2012) requests,
- facilitates the adoption of the economic provisions in favour of a greener agriculture foreseen by the new CAP,
- facilitates the cooperation among the formal sector and the networks of farmers and farmer organizations.

4. The Italian Context

4.1. The Italian National Plan for Agro-biodiversity

In Italy 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.

To be noted in addition, the Ministry of Environment (Ministero dell'Ambiente e della Tutela del Territorio e del Mare) has the responsibility of protecting wild habitats and populations, crop wild relative populations included, which also are important PGR.

Italy has been the first country in Europe to protect Genetic Resources and LR with specific Regional and national legislations. Tuscany and Lazio Regions preceded the State in adopting and implementing policies protecting local genetic resources with specific Regional Laws (see below).

Italy was also the first in Europe that developed specific 'Guidelines for the Conservation of Genetic Resources for Food and Agriculture' (http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/305, in Italian), as a first step to meet its National Plan for Agro-biodiversity, whose Phases are graphically described in Figure 1.

As for plants in particular, a 'Summary 'of these Guidelines was submitted by the Italian Government to the ITPGRFA (FAO 2001) for the implementation of Article 6 (http://www.planttreaty.org/sites/default/files/Submission_Italy.pdf). Both documents are downloadable from the PGR secure web site LR helpdesk (http://www.pgrsecure.org/).

In the above mentioned Guidelines for the Conservation of Genetic Resources for Food and Agriculture, the focus is on *in situ* (on-farm) conservation of *sensu stricto* LR. This 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 the country. The main steps in the Italian approach to *in situ* (on-farm) LR conservation are identified by the Guidelines as follows:

1. Collection of information on existing LR (inventory) and collection of propagation material for *ex situ* back up and for characterization;

2. Identification of the areas where to carry out *in situ* (on-farm) conservation actions with priority (i.e. the Most Appropriate Areas, MAPAs);

3. Characterization and assessment of the distinctiveness of local varieties;

4. Assessment of population size and genetic structure of local varieties maintained *in situ* (on-farm);

5. Monitoring the effectiveness of on-farm (*in situ*) conservation (periodic assessment of the maintenance of an adequate level of genetic diversity and absence of genetic erosion);

6. 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 in a subsequent Phase B (Fig. 1). Some of them have already taken these steps in the frame of their Regional laws, some others have not yet.

Lastly, because of the MIPAAF coordination role, the National Plan for Agro-biodiversity foresees the collation of Regional data into an Italian inventory of genetic resources in its last Phase C. Finally, in this phase, based on the national inventory, the implementation of actions at national level to protect and value PGRFA are foreseen (Fig. 1).

This PGR Secure deliverable, beside on the European strategy, inputs on Phase C of the National Plan for Agro-biodiversity: within the PGR Secure project, the first catalogue of *in situ* (on-farm) maintained LR was compiled (Negri *et al*. 2013, see also below).

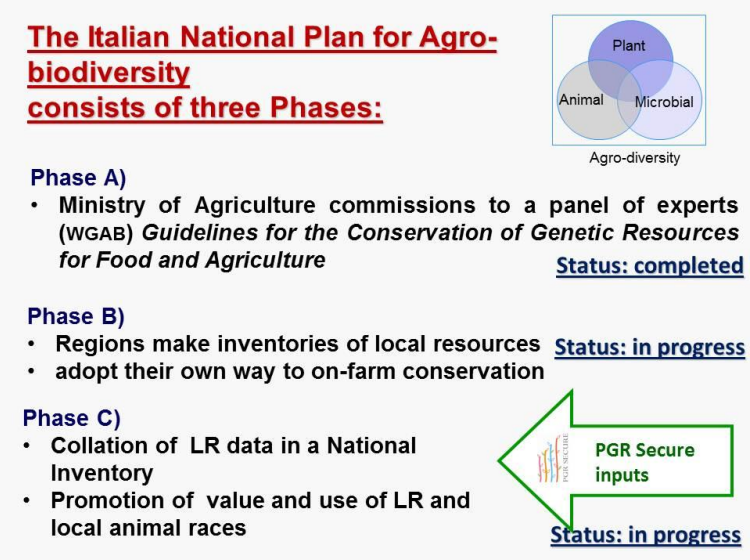

Figure 1. The Italian National Plan for Agrobiodiversity and its present achievements.

However, the National Plan for Agro-biodiversity also recognizes the need of a safe back up of PGR *ex situ*, also considering that, in some cases, there is the opportunity of reintroducing LR in their territory of origin.

Some information about *ex situ* Italian collections is reported in the Guidelines for the Conservation of Genetic Resources for Food and Agriculture. There are several public collections of *ex situ* maintained, often unique, PGR in Italy (in scientific institutions) whose materials and data start to be inventoried in a national catalogue just now.

Overall, there is not yet a complete national picture of the different conservation activities that are carried out both *in situ* and *ex situ* and the entire Plan is to be fully realised in the future.

4.2. The Italian Regional Laws

As mentioned above, Regional laws exist that protect agro-biodiversity in Italy. The Tuscany Laws no. 50/1997 and the Lazio Law no. 15/2000 were the first. Other Regional laws followed: the Umbria Low no. 25/2001; Friuli Venezia Giulia Law no. 11/2002; Marche Law no. 12/2003 and Emilia Romagna Law no. 1/2008, while many other Regions have not implemented a law or have laws under discussion (Fig. 2).

The Italian Regional legislation clearly aims to protect local agro-biodiversity, with the declared goals of:

- support *in situ* and on-farm conservation of protected genetic resources (plants and animals), i.e. to support their cultivation (and breeding) on the farms, within the Region ;
- where possible, favour the reintroduction or extension of culture(or breeding) of protected genetic resources;
- assign to 'guardian' farmers (or breeders), under the strict control of the Region, the multiplication of genetic resources that they themselves have conserved up to present day, by providing them with the necessary assistance to enhance the techniques for the multiplication and propagation of material (breed);
- control the exchange of the propagation material produced and make it available both to the farmers that apply for it for cultivation (or livestock rearing), and for scientific purposes such as genetic selection and improvement;
- apply cultivation (or livestock rearing) 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.

All of the Italian Regional legislation are quite similar.

Figure 2. Present status of the Regional legislation on genetic resources for food and agriculture.

Autochthonous plant (and animal) genetic resources, including wild plants, such as species, races, varieties, populations, cultivars, ecotypes, and clones for which there is an economic, scientific, environmental, or cultural interest and that are threatened by genetic erosion, are protected.

The term 'autochthonous' means genetic resources of Regional origin or introduced and integrated into the Regional agro-ecosystem in the past 50 years. PGR that have disappeared from the Region but have been *ex situ* maintained in botanical gardens, public or private institutions of other regions or countries are also included, so that reintroduction of LR in cultivation is also foreseen.

In the context of farmer's rights, the laws (sometimes) clearly state that "… the heritage and ownership of the genetic resources belongs to the indigenous local communities, within which the benefits must be distributed equally...".

These laws are generally implemented by Agencies with funding coming from the European Agricultural Fund for Rural Development (EAFRD) under EU Regulations EC 1698/2005 and 1974/2006 through the Regional Rural Development Plan.

The implementation plan foresees several phases (Fig. 3; see also Costanza *et al.* 2012): 1) There is an initial inventorying phase (genetic resources are identified, their existence checked by inspections in the farmer fields; data collected in the fields are cross-checked against other sources of information). 2) In the second phase each genetic resource is characterized for morpho-phenological traits and, eventually, also for genetic traits by using molecular markers. 3) On the basis of the information gathered in the previous phases, the identity, autochthony and threat of the genetic resource is assessed by a scientific commission. 4) Only after a positive assessment by the commission, a certain genetic resource is registered into the Regional Voluntary Genetic Resource Register and enters into the planned protection scheme.

The Regional Voluntary Registers are official records of the Regions and include Plant and Animal Sections (Porfiri *et al.*, 2009).

The protection scheme is realized as *in situ* conservation by a 'Farmer Conservation and Safety Network', and as *ex situ* conservation by the Agencies, which collect and store propagation material in genebanks and field collections.

Members of the Farmer Conservation and Safety Network can be public and private institutions, 'associations of interest' and single or associated farmers; the conservation activities of the network are coordinated by the Agencies. Through the network, the genetic resource is cultivated across years in the area where it was initially found, but an enlargement of the genetic resource cultivation area, through seed increase and seed exchange among local farmers, is also foreseen.

For example, the Lazio Region network currently involves 255 farmers (Costanza *et al.* 2012). To maintain genetic resources on their farm, farmers receive monetary incentives, established on the basis of the type of cultivated crop (rates are in the range of € 250–300/ha for cereals and € 500–600/ha for vegetables). In 2012, 172 plant LR were protected in the Lazio Region (138 fruit tree LR belonging to 13 different species, and 34 herbaceous crop LR, belonging to 14 different species) (Costanza *et al.* 2012).

In Emilia Romagna Region a public-private system is being developed for fruit trees that makes available propagation material of old LR to those farmers/private citizens who are willing to reintroduce these LR in cultivation (D. Missere, Centro Ricerche Produzioni Vegetali, pers. comm.).

It is on the basis of these regional experiences, that Italy recently adopted the above mentioned ''Guidelines for Conservation of Plant Genetic Resources for Food and Agriculture''.

Overall, it appears that the Italian Regional laws could facilitate:

- the compilation of National Inventories based on the Regional Inventories, which are the information base necessary for any conservation action,
- further registration of LR as 'conservation varieties' in the European Conservation Variety Register,
- wider commercialization of seed of (at least some) LR,
- easier promotion of products from LR and, consequently,
- wider *in situ* (on-farm) conservation.

In this respect it would be desirable that all the Italian Regions approve and implement laws similar to those described above.

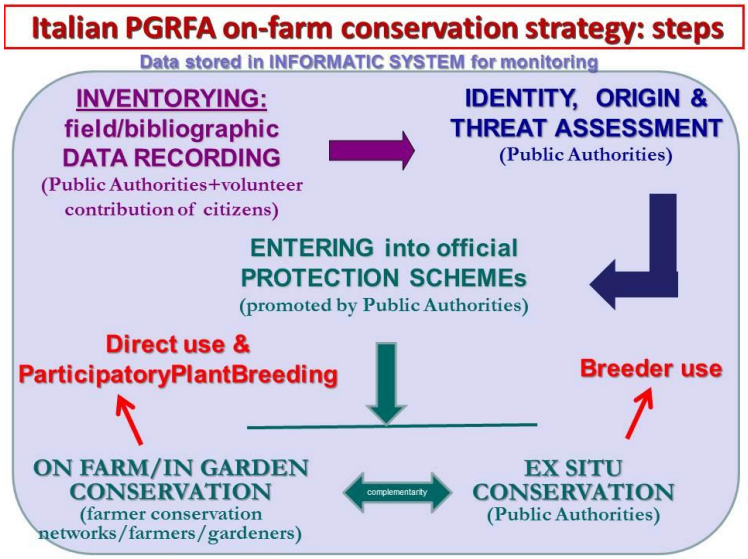

Figure 3. Implementation steps of the Italian Regional laws for PGRFA *in situ* (on-farm) conservation.

4.3. Present *In Situ* (On-Farm) Conservation and Use of LR in Italy

If LR are still maintained on-farm (*in situ*) it is because they are used. To understand motivations for use can then help in designing an on-farm conservation strategy because, in turn, a strategy should be aimed at enhancing motivations and then use. Following here we review the different motivations for LR use and conservation in Italy, giving some of the many examples available (detailed presented in annex 1).

Many Italian LR are presently used to give wines that are awarded the Controlled Designation of Origin (DOC) and Controlled Designation of Origin Guaranteed (DOCG). Other crop LR are also used to give products that are awarded quality marks like Protected Designation of Origin (PDO, Protected Geographical Indication (PGI) Traditional Specialty Guaranteed (TSG) or Certified Product from Organic Agriculture ("Sagrantino di Montefalco", "Nostrano di Storo" and "Farro di Monteleone di Spoleto" examples 1, 2 and 3, respectively, in annex 1). They are commercialized across all Italy, also taking advantage of commercial chains that are specialized in typical food (like Eataly, example 4).
It should also be noted that many products that come from LR, although not awarded with quality marks, are highly requested by the local markets because of the appreciation of consumers for typical food deriving from them ("Fagiolina del Lago Trasimeno" and "Sedano Nero di Trevi", examples 5 and 6,

respectively). They are also often promoted through the organisations of local fairs ("Pera Cocomerina", example 7). Typical products resulting from LR are also promoted by the Italian Academy of Cuisine founded in Milan, Italy on July 29, 1953 and are often offered to tourists in the local restaurants. In some cases, their commercialisation on the local markets is promoted by specific campaign run by farmer organisations (like the "Campagna Amica" campaign, example 9). Some other products from LR are recorded among the Slow Food Presidia and also gain the attention and prize of niche consumers ("Pera Cocomerina", example 7).

Other LR are only used in a certain family and cultivated in its home garden (several species, Negri 2003) because of appreciation and traditional use of that particular family. LR that are maintained *in situ* for these reasons are quite frequent in Italy (just to give an example, five different LR of melon were recently discovered in a single home garden) and also the most threatened, because their survival *in situ* depends on the continuation of the family tradition across time.

LR can be found in convents or monasteries, as residuals of previous monastic cultivations, and used to restore historical places (example 9).

Some LR are also used and maintained on-farm because they guaranty specific adaptation to particularly adverse pedoclimatic conditions. For most of the forage LR better persistence than modern varieties, adaptability and good productivity under difficult or harsh conditions are the main reasons reported (Negri 2003).

However, multiple reasons are often recorded for on-farm conservation of the LR crops used in the human diet. As many of the above mentioned examples, "Solina di Abruzzo" wheat (example 10) is maintained not only because of its tolerance to difficult pedoclimatic conditions, but also because of the quality of the products obtained, the family traditions and its adaptation to organic management system which is widely applied in the cultivation area.

As a matter of fact, in Italy, LR are also used in environmentally friendly types of agriculture; many organic farmers already use LR and an increasing number of organic farmers is looking for LR seed to be used in organic farming.

There are also a examples of recent varieties (in *Brassica* spp., Branca *et al.* 2002, 2007, and in *Medicago sativa* L., Falcinelli and Torricelli 2004, example 11) directly developed from LR that were successfully commercialized. A participatory breeding program has recently been funded by EC, involving partners in 14 European countries (SOLIBAM project) that use LR as basic material for developing new varieties of several species for environmentally friendly (i.e. organic) agriculture. Within this project UNIPG is developing new varieties of barley, bean and broccoli with broad genetic base derived from LR (Raggi *et al.* 2014; Tissi *et al.* 2014; Torricelli *et al.* 2014). To make available LR or varieties derived from them to the organic farmer sector can help survival of (at least part of) LR diversity in the fields.

Finally, as for the prevalent destination of Italian LR, a previous study (Negri 2003) recorded that 63.5% of the total number of accessions were prevalently used in human diet (including some barley accessions used for a coffee-like beverage) and 36.5% as forages. Concerning the LR used as food, the majority 67.1% were used within the family, 9.2 % were prevalently sold on the local market and 23.7% were prevalently sold on a wider market. Almost all of the forages were used directly on the farms (96.8%) and only 3.2% were destined to the local markets, while none was sold on a wider market. Negri (2003) also recorded that the majority of LR are cultivated by elderly farmers.

4.4. Present Coordination Among Different Conservation Activities and Opportunities

The frame outlined above is very complex and the country is rich in diversity useful for agriculture (see Landucci *et al*. 2014 and Negri *et al*. 2013, respectively for crop wild relatives and LR), as a consequence, obviously, not only to have an overall picture, but also to promote and to coordinate different PGR conservation activities in Italy is not easy.

Because of i) different PGR being under the aegis of different Ministries (e.g. LR under the Ministry of Agriculture, crop wild relatives under the Ministry of Environment), ii) each single Region (or Autonomous Province) having the responsibility to plan and implement measures in favour of conservation, ii) farmers being the subjects who realize *in situ* (on-farm) conservation in practice and iv) Italian public scientific Institutions being in charge of maintaining *ex situ* collections, a high integration between different subjects and different activities is needed.

In this respect, then, even if overall the present context in Italy can be considered a favourable one, it would be desirable that the Ministries should take a more active coordination role and some Regions (or Autonomous Provinces) a more active role in planning and implementing actions to achieve an efficient and effective *in situ* (on-farm) and *ex situ* conservation.

For example, concerning unique *ex situ* collections maintained at scientific institutions (like Universities or Research Centers), it should be noted that they are often maintained without specifically dedicated funds, while, because they are of public utility and often fully accessible to breeders and other potential users, these funds should be provided by the public Bodies under which the responsibility of conserving PGR lies.

This lack of coordination among the Public Bodies under which the responsibility of conserving PGR lies and of dedicated funds severely hampers a proper conservation of whole Italian PGR.

Specifically referring to *in situ* (on-farm) conservation of LR, better awareness of the existence of available funding opportunities within the EU context and better use of them should be achieved. Within the CAP, for example, as seen above, there are funding opportunities for implementing measures in favour of *in situ* (on-farm) conservation.

To take better advantage of the present European seed legislation (Commission Directives 2008/62/EC, 2009/145/EC and 2010/60/EU, see above) could also further promote LR *in situ* (on-farm) conservation (both in those Regions where specific laws do not exist and, in the Regions where a law exists, to usefully complement the present provisions). To be underlined about this, it is that in Italy a LR can be registered for free (Spataro and Negri 2013).
For *sensu stricto* LR, as the majority of Italian LR are, a fail in registration appears to be a loss of opportunities. If, on one hand, the registration of a LR has a meaning when the seed is expected to be traded in large quantity, on the other hand it is a sort of official protection for those LR that have a limited seed market and commercial interest. With the registration, the LR is officially identified and permanently linked to a particular territory where it is maintained, even if its seed is not necessarily certified and traded (*per se* the registration into the Common Catalogue does not force the seed marketing of any type of variety) (Spataro and Negri 2013). On the matter, it should be noted that the Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture recommend that *in situ* (on-farm) conservation activities should be focused on *sensu stricto* LR in their region of origin.

In addition, the registration of LR as 'conservation varieties' can promote the development of local seed industries that are aimed to at producing and commercializing LR seed, of these activities also local farmers can take part and find another source of income (Raggi *et al.* 2013).
In spite of all that, at present, the Directives application In Italy has only partially favoured the registration of LR maintained on-farm. It seems that there is scarce awareness of this opportunity in Italy since, as of January 2013, only 17 Italian LR (8 maize, 1 potato and 8 horticultural crops) were registered in the European Conservation Variety Catalogue and used in the regions of origin (Spataro and Negri 2013).

The Regions and the Autonomous Provinces could directly take the initiative of registering (or should promote the registration of) the inventoried LR as 'conservation varieties'.

In order to facilitate LR maintenance in a certain territory or reintroduction activities, other initiatives, like supporting the creation of 'Community seed banks' run by farmers, could be promoted by Public Bodies and under their control (see example 12 in annex 1).

Finally, all the involved stakeholders (i.e. Public Bodies, farmers/citizens and their associations) should cooperate at best for enhancing motivations and promoting the use of LR, basing the latter action on the particular characteristic and/or use of each LR.

5. Research Issues For An Efficient and Effective *In Situ* (On-Farm) Conservation

LR are key sources of genetic variation for sustaining agricultural diversity, increasing productivity and enhancing local value chain. In a context of a food security challenge, due to climate changing and unpredictability, and of LR extinction threat there is an imperative to maintain LR diversity *in situ* (on-farm) and increase and enhance their use.

To support a future, efficient and effective *in situ* (on-farm) conservation, there are a number of particular areas of research that are needed to improve our knowledge:

- Level of present among- and within- LR diversity of Italy,
- LR population dynamics in relationships to factors such as migration, drift and human and environmental selection pressures,
- Impact of climate change on LR diversity and how LR might be managed to adapt, mitigate effects or be resilient to the climate change effects in the face of its potential impact,
- LR among- and within-diversity role in contributing to the maintenance of other living beings and, in general, of environmental friendly agronomic systems.
- Identification of genes that underpin evolution and key genetic traits for robustness (e.g. resistance against biotic and abiotic stresses, adaptation to local conditions) and quality that will facilitate their broader use in the formal and informal (farmer guided) crop improvement sectors. They can also be useful in the monitoring of effectiveness of *in situ* (on-farm) conservation actions (i.e. in the periodic assessment of the maintenance of an adequate level of genetic diversity and absence of genetic erosion).
- Identification of agro-biodiversity rich areas (i.e. MAPAs) where to promote LR *in situ* (on-farm) conservation actions with priority.

To these needs of the research also the Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture make specific reference.

6. The First Inventory of *In Situ* Maintained Landraces of Italy

6.1. Compiling An Inventory Is The First Step In Conservation

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 (Box 1).

The compilation of inventories is also a contribution to the implementation of ITPGRFA (Article 5c) of which Italy, as many European countries and the EU are contracting parties. ITPGRFA Article 5c reads as follows: "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''.

The 2nd GPA (FAO 2011) policy and strategy for *In situ* Conservation and Management also 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''.

The inventory has been aimed to support the development of LR conservation activities in Italy following the above mentioned Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture (http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/305, see section 4) and, is an example for the whole Europe.

It can also facilitate the promotion of the products that are obtained from LR, as typical products that are strictly linked to a certain territory and the registration and marketing of LR seed (see the Commission Directives 2008/62/EC 20 June 2008, 2009/145/EC 26 November 2009 and 2010/60/EU 30 August 2010 on "conservation varieties") (Spataro and Negri 2013). Finally, it is an informative basis for those farmers who are looking for crop variable populations to be used in low input and organic agriculture.

The compilation of an Italian inventory of *in situ* (on-farm) maintained LR, and the consequent definition of an Italian strategy for the *in situ* conservation of LR, funded by the PGR Secure project fits very well in this scenario.

6.2. Methods Used

6.2.1. The compilation of the inventory

We had to compile an ''official'' inventory since the deliverable of the WP4 are public. The complexity of the administrative Italian complicated the matter. 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. D4.6 and D4.7, the '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.

6.2.2. Eco-geographic diversity data and analysis

On the basis of the collected data, in order to analyse the density and distribution per Region the inventoried LR were initially mapped by using an orthophoto map and software GIS. Each LR was duly located thanks to the geographic coordinates (latitude and longitude in decimal format) collected. Altitude was calculated (m a.s.l.), by the Digital Terrain Model (available on the national website of the National Cartographic Portal http://www.pcn.it). The same procedure was used to record density of *Avena, Beta, Brassica* and *Medicago sensu stricto* LR per region.

6.2.2.1 LR density per Region and distribution analysis

In order to analyse the LR density and distribution for each Italian Region the number of LR species were counted and the Regions with the highest LR number were identified.
The LR species were grouped in 7 crop groups (fruit trees, vegetables, grain legumes, forage crops, cereals, ornamental plants and others).

6.2.2.2 *In situ* vs *ex situ* LR gap analysis

As a second step towards the compilation of the Italian LR conservation strategy, a gap analysis was carried out matching EURISCO data about accessions with the status of LR and with an Italian origin with data included in the above mentioned First Inventory of *In situ* Maintained Landraces of Italy (Negri *et al.* 2013).

6.2.2.3 Identification of the Most Appropriate Areas (MAPAs) for conservation

In order to satisfy step 2 of the Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture (http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/305), we also identified the Most Appropriate Areas (MAPAs) for conservation, following the holistic approach mentioned above.

Initially, the Italian country area was subdivided into quadrants, starting from the 2008 IUCN grid with cell grids size of 2x2 km, which were then united to obtain a cell grid of 20x20 km grids, each cell being georeferenced using theWGS84-UTM32N system (EPSG: 32632). 995 quadrants were obtained.

The identification of MAPAs was carried out by gathering different sets of data per unit of territory (400 square km) and applying to these data a set of criteria.

The criteria applied (that were previously discussed, applied and checked in their practical application in the frame of the AEGRO project, Negri *et al.* 2012) were:

- Criterion 1 LR diversity: the number of LR species present in the considered area (i.e. LR density; species richness)
- Criterion 2 Agroecosystem ecological diversity
- Criterion 3 Presence of Protected Areas.

To apply criterion 1 the Number of LR and the Shannon Diversity Index were calculated for unit area (i.e. each single 400 km^2 quadrant).

To apply criterion 2 the Corine Land Cover2006 (CLC 2006) was used. The 16-4/2012 version derived from the up-dated CLC 2006, based on satellite photographs (SPOT-4 HRVIR, SPOT 5 HRG and/or IRS P6 LISS III). This system is available for the whole of Europe at present and will be further enhanced and extended. To identify MAPAs, the land use classes 2 (Agricultural areas), 3 (Forests and semi-natural areas), 4 (Wetlands) and 5 (Water bodies) were considered the most relevant to be taken into account.

To apply criterion 3 the information of the Elenco Ufficiale delle Aree Naturali Protette (Ministero dell'Ambiente e della Tutela del Territorio e del Mare 2011) and Natura 2000 Network was used. Criteria were applied to the data sets following two prioritization strategies: a Restrictive Strategy and an Additive Strategy.

In the Restrictive Strategy the criteria were applied in sequence, and for each index a threshold was defined below which areas were not admitted to the following level. The passage from one step to the next took place after having excluded the quadrants with a value lower than that of the thresholds.

The Additive Strategy applied the same criteria but the index values and threshold were standardized through an angular transformation process for each quadrant. A representative threshold was then established for identifying the MAPAs.
In order to apply the above mentioned strategies, for each index a threshold was defined to which an area was not admitted to the following level (area discrimination).

6.3. Results

6.3.1. Italian LR Inventory

4806 accessions belonging to 2365 LR were inventoried across Italy were officially recorded (Negri *et al.* 2013, see also http://vnr.unipg.it/PGRSecure/start.html) using the tools developed in the PGR Secure project (i.e. D4.6 and D4.7).

It is worthwhile noting that an examination of both the literature in impact factor journals and Italian grey literature on genetic resources (i.e. that published in the Proceedings of the National Congress on Biodiversity, Congresso Nazionale Biodiversità, held in Massafra, Taranto 1995, Matera 1996, Reggio Calabria 1997, Alghero, Sassari 1998, Caserta 1999, Bari 2001, Catania 2005, Lecce 2008 and Bari 2012) shows that in Italy there are many other LR (and especially fruit trees, olive trees and grapevines) that are not officially recorded.

In addition, there is lack of information from some Regions which have not inventoried their LR, not even those that are important for the local economies such as those that are awarded quality marks (like Protected Designation of Origin or Protected Geographical Indication).

Finally, not previously recorded *sensu stricto* LR continue to be recorded year after year. For example, in just one year and in a restricted area of Umbria, UNIPG collected information about 2 new tomato LR and 5 new melon LR held by local farmers. Consequently, there is the need to continuously search the territory for extant LR.

Then, the compiled inventory is only a partial one: many of the existing LR have not been officially inventoried.

Apart from a few cases, most of the LR are conserved in family gardens and mostly by elderly farmers. Few people, many of whom are old, are remaining in the country. They often declared that they felt unable to carry on their activity any longer. So the LR extinction is still in progress and mostly depends on the ageing of the country populations which is a social problem. Other reasons are also acknowledged.

The younger people remaining in the country are often part-time employed in agriculture and often find it more convenient to buy the seeds from the market than reproduce them. Seed harvesting, cleaning and conditioning requires time and sometimes appropriate equipment which cannot always be present on the farm. Lack of skill is another constraint in reproducing seed or propagating plants, since the younger farmers are often unable to practice techniques usually applied in the past (such as grafting). This makes it difficult to increase cultivation or, even more troubling for PGR conservation, continue cultivation.

6.3.2. Italian LR distribution analysis

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. 4).

329 species are cultivated as LR, among them fruit trees, vegetables, grain legumes, forage crops, cereals, ornamental plants and other species are included.

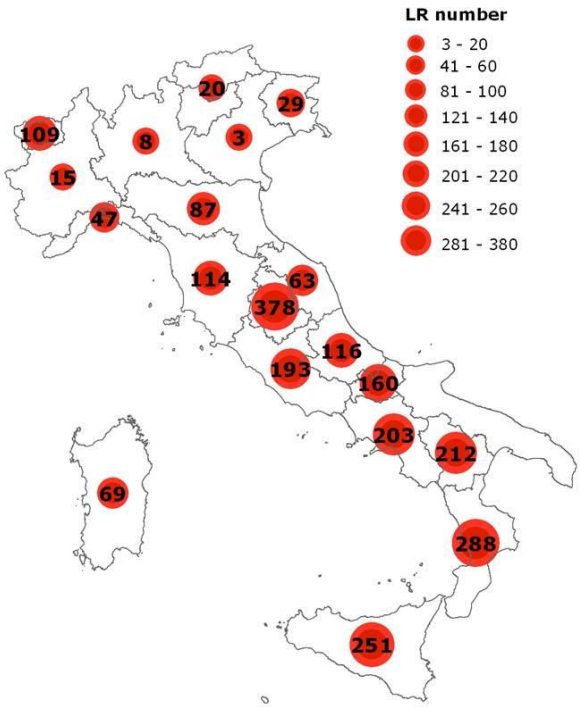

Figure 4. LR distribution by Italian Region (as communicated by each Italian Region).

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) (Fig. 5), showing that they are mostly used for human food (contrary to what recorded in Negri 2003).

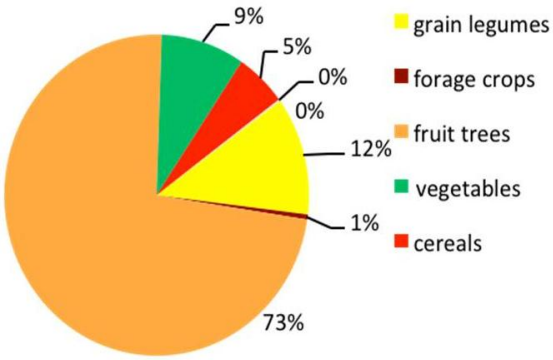

Figure 5. Landrace percentage per crop groups

6.3.3. Eco-geographic diversity data and analysis

The inventory mostly includes LR of *Prunus* (18.5%), *Malus* (16.7%), *Pyrus* (14.3%), *Vitis* (9%), *Phaseolus* (7%), *Olea* (4.8%), and, to a lesser extent, *Ficus, Solanum* and *Capsicum*. The 4,806 LR are distributed from sea level to mountainous areas. *Pyrus* (513 m a.s.l.), *Malus* (493 m), *Phaseolus* (464 m), *Olea* (412 m), *Vitis* (349 m) and *Prunus* (430 m) are generally found in hill sites. *Capsicum* LR are mainly found on the plains of Piemonte (262 m).

Most LR are found at low latitudes, between 37°N and 41°N. *Capsicum* (44.24°), *Vitis* (42.89°) and *Prunus* (41.81°) occur, on the average, in a more northerly position, while *Malus* (41.79°) and *Pyrus* (40.96°) are found more to the south.

As regards the longitude, *Capsicum* (8.22°) shows concentrated, circumscribed values, while *Prunus* (13.2°), *Malus* (13.48°) and *Pyrus* (14.38°) are more widespread.

Data for target crops were also extracted from The First inventory of *In Situ* Maintained Landraces of Italy (Negri et al 2013, see also http://vnr.unipg.it/PGRSecure/start.html). In Italy, 1 *A. sativa*, 2 *Beta vulgaris* L., 1 *B. napus* L., 27 *B. oleracea* L., 12 *B. rapa* L., and 45 *Medicago sativa* L. LR were officially recorded. As mentioned for all crop LR, it is known from recent bibliographic data, personal observation and communication of colleagues (prof. F. Branca, University of Catania, dr. L. Maggioni, ECPGR) that for target crops other LR exist in Italy that have not been recorded in an inventory yet (see for example Ciancaleoni *et al.* 2013, 2014; Laghetti *et al.* 2005). The *A. sativa* LR was found in Molise Region, the 2 *B. vulgaris* LR in Tuscany and Umbria Regions, respectively, the *B. napus* LR in Umbria Region, The *B. oleracea* LR in Friuli Venezia Giulia, Tuscany, Umbria, Molise and Lazio Regions, *B. rapa* in Umbria, Molise and Lazio Regions and the *M. sativa* LR in Umbria and Abruzzo Regions. Considering the scarcity of data an analysis of ecogeographic diversity was only possible for *B. oleracea, B rapa* and *M. sativa*. For *B. oleracea,* which was found in plains and hilly sites, latitude ranged from 46.20 to 41.48 N, longitude from 14.05 to 10.52 E. For *B. rapa,* which was also mostly found in plains and hilly sites but for which two locations were recorded in mountain sites above 500 m a.s.l., latitude ranged from 41.48 to 43.21 N, longitude from 12.04 to 14.88 E. Finally, for *M. sativa*, which was found from sea level up to 900 m a.s.l., latitude ranged from 42.02 to 43.36

N, longitude from 12.34 to 14.47 E. Considering the high geographic diversity of the Italian territory, a high genetic diversity of these LR can be supposed. In particular, it is striking that *M. sativa* LR are found in such diverse locations.

6.3.4. *In situ* vs *ex situ* LR gap analysis

This gap analysis showed that most of the LR inventoried in Italy (97.4%) have no matching record in EURISCO and seems not to be conserved in the main genebanks.
In particular for target crops, out of the 88 LR that were recorded *in situ* only 44 (50%) are also conserved *ex situ*, having EURISCO as a source of information. 36 LR out of the latter are conserved at our Department, the others in Regional gene banks. It should be noted on the matter that these gene banks, not receiving enough support have problems in managing these accessions and especially in multiplying and distributing germplasm when requested.

In general, LR are often maintained in as working collections in (often) small genebanks, mainly devoted to research, if public, or to breeding, if private, than to conservation purposes. The former do not receive public funds to maintain, document and multiply accessions, and are not purposely structured (or able to) to distribute accessions. As a consequence, *ex situ* collections cannot be sources for intro/reintroduction activities of LR which will usefully complement present *in situ* (on-farm) conservation.

6.3.5. Identification and prioritization of Most Appropriate Areas (MAPAs) for conservation

Using the Restrictive Strategy 53 MAPAs were prioritized (Fig. 6, b-e), mainly located in the Regions of Lazio, Abruzzo, Molise, Umbria and Basilicata.

The Additive Strategy prioritized 123 MAPAs (Fig. 6, f-i), a larger number than identified with the Restrictive Strategy. The areas defined by means of the Restrictive Strategy are entirely included in those defined by means of the Additive Strategy.

The main difference between the two strategies lies in the fact that the Additive Strategy identified a number of MAPAs in Regions which were not identified by the Restrictive Strategy (Fig. 6).

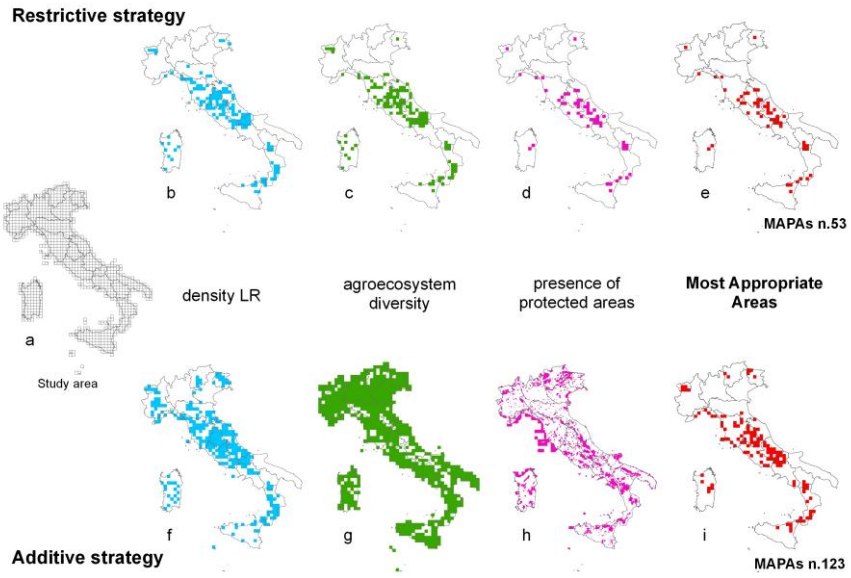

Figure 6. Italian MAPAs that were identified following the Restricted and the Additive prioritization strategies.

7. Present Constraint Identification And Prioritization Of Future Actions For An Efficient And Effective *In Situ* (On-Farm) Conservation In Italy

The Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture have already identified the steps to be taken for an Italian efficient and effective *in situ* (on-farm) conservation of LR.

To that end, the exam of the international and national context, of the available literature and of the data gathered during PGR Secure highlights that there are main constrains to be immediately overcome, which are summarised below:

- Inventories compiled up to now are incomplete.
- Lack of safe LR back up in *ex situ* conservation.
- Insufficient coordination between Public Bodies that have the responsibility of conserving PGR (State, Regions and Autonomous Provinces) and insufficient coordination between them and other Institutions involved in *ex situ* and *in situ* (on-farm) conservation activities.
- Lack of adequate funds for appropriate *ex situ* and *in situ* (on-farm) conservation actions for LR and for research issues concerning on farm conservation.
- Lack of coordinated and integrated plans for appropriate *in situ* (on-farm) conservation for those LR that have scarce possibilities to reach the market (home garden crop LR).

Future steps towards an effective and efficient conservation strategy should principally rely on overcoming the above mentioned constrains.

- The work carried out in PGR Secure also highlights that enhancing use is a mean to *in situ* (on-farm) conservation (see section 4.3. above and examples in annex 1).

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

Based on the political context, the information we gathered compiling the inventory and the comparison with other source of information, the primary needs for a strategic approach to conservation of Italian LR are identified in conservation and enhancement of use actions. Recommendations for the next future to the Public Bodies under which lies the responsibility of LR conservation and local stakeholders are shortly presented below.

8.1. Conservation Actions Needed

- Public Bodies under which lies the responsibility of LR conservation should c**omplete the national inventory** and continuously update it. To gather information on LR still maintained *in situ* (on-farm) that are known to exist, but have not been recorded yet is needed. Both the exam of the literature and recent LR discovering show that many LR exist that are not inventoried. Not previous recorded LR are continuously found which suggests the need for a continuous search. Inventories are the needed information basis for any conservation action; in addition they can facilitate the promotion of the products that are obtained from LR, the LR registration in the European Common Catalogue as 'conservation varieties' and in the end, the use of LR by farmers (see below).

Other conservation actions concern:

- **Awareness** of the Public Bodies under which lies the responsibility of sustaining LR survival on the farms and their maintenance *ex situ* through appropriate policies and actions **should be increased**. As seen above, not all Italian Regions and Autonomous Provinces have a law to protect PGR or appear to have started a conservation plan although National Plan for Agro-biodiversity exists. In addition, at present, actions soliciting Regions to take on commitments in favour of LR conservation appear to be feeble. To increase awareness is the first step in taking on a serious commitment and effective actions in favour of LR conservation.

- Public Bodies under which lies the responsibility of LR conservation should promote **safe back up of LR** in public ***ex situ*** collections, since gathered data show that almost all of the LR inventoried in Italy are not conserved in the main genebanks. Considering that most of LR are under threat of extinction, there is a pressing need to collect and safely store them *ex situ*.

- Public Bodies under which lies the responsibility of LR conservation should **increase** their **coordination** in developing and implementing measures for LR conservation and use.

- Public Bodies under which lies the responsibility of LR conservation should **develop specific conservation actions for home garden LR** (i.e. horticultural crop LR) which are fundamental PGR for Italian economy and future food security, while being the type of LR under major threat (see also below).

- Last, but not least, Public Bodies under which lies the responsibility of LR conservation should provide **adequate funds for *ex situ* and *in situ* (on-farm) conservation** and, specifically for the latter, following the Italian Guidelines for the Conservation of Genetic Resources for Food and Agriculture, initially **concentrating efforts on the most threatened LR and on MAPAs**. The European Policies already foresee measures for increasing agro-biodiversity than can be used to the purpose.

- Public funds are also needed to **support research** aimed to understand the level of genetic diversity which characterize LR, 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 (see also below).

8.2. Enhancement of Use Needed

- The **registration of LR as 'conservation varieties' should be promoted** and/or directly carried out by the Public Bodies under which lies the responsibility of LR conservation. As discussed above, 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.

- Public Bodies under which lies the responsibility of LR conservation and other public stakeholders (like Municipalities) should **promote the use of home garden LR 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 take advantage of local LR. 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 LR, i.e. those belonging to horticultural crops.

- Public Bodies under which lies the responsibility of LR conservation, other stakeholders (like Municipalities), private farmers/citizens and their associations should better **promote the awarding of quality marks for products coming from LR**. 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 Bodies under which lies the responsibility of LR conservation, other public stakeholders, private farmers/citizens and their associations should better **promote typical, local products coming from LR**. The traditions and the organoleptic peculiarities, which continue to make some LR highly valued and keep the prices high on the local and city markets, are the reason why they have been maintained up to now. As a consequence, the 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. Strengthening the relationships between the agro-food system and the community based management of plant genetic resources could lead to an 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 reality.

- In this respect a **wider diffusion of campaigns aimed to promote local economies based on nearby products** (like the "Campagna Amica") could help in achieving *in situ* (on-farm) conservation if they are based on LR to a greater extent than at present.

- Public and private stakeholders **should promote the use of LR in plant breeding and participatory plant breeding programs,** especially those aimed at creating varieties suitable to environmentally friendly agronomic systems.

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10. Most Used Acronyms

CAP: Common Agricultural Policy

CBD: Convention on Biological Diversity

EU: European Union

EAFRD: European Agricultural Fund for Rural Development

GPA: Global Plan of Action

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

LR: Landrace/s

PGR: Plant Genetic Resources

PGRFA: Plant Genetic Resources for Food and Agriculture

Annex 1. Examples of successful on-farm conservation and use of LR in Italy

Example 1 - "Sagrantino di Montefalco" vine LR

"Montefalco Sagrantino secco", a dry DOCG red wine, and "Montefalco Sagrantino passito", a sweet DOCG red wine, are both obtained exclusively from Sagrantino LR grapes, only produced in the Province of Perugia, in the Umbria Region of central Italy (Fig. 1). The local income from this LR can be estimated in about 60 million euro (www.consorziomontefalco.it). Sagrantino di Montefalco is a good example of successful use of quality marks for the promotion of a product obtained from a LR.

Figure 1. Wine and vines of **"**Sagrantino di Montefalco" LR, http://www.arnaldocaprai.it/

Example 2 - "Nostrano di Storo" maize LR

The Italian LR '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. 2). It represents a niche crop with important social and economic significance for local people. This LR of maize has originated from an ancient introduction and has been grown in the area since mid 18th century.

This LR 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 passed 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). Although 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 can be estimated in 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.

Overall it is a nice example of successful on-farm conservation and use of a LR in Italy.

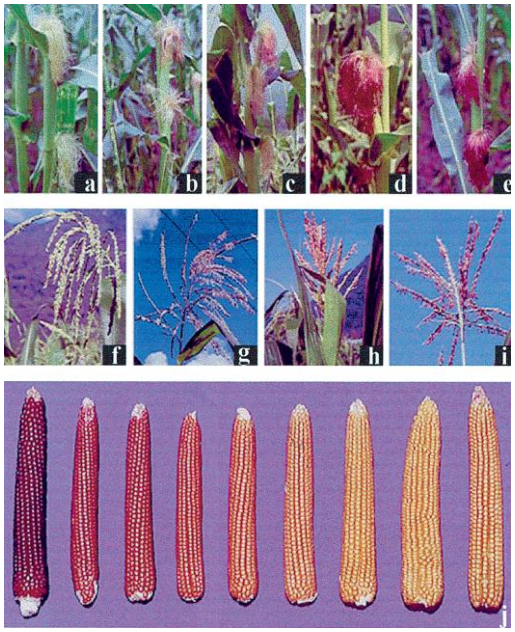

Figure 2. Examples of the phenotypic variability of silks (a–e), tassels (f–i), and ears (j) of the "Nostrano di Storo" maize LR (from Lucchin *et al.* 2003).

Example 3- "Farro di Monteleone di Spoleto" emmer LR

In Italy emmer (*Triticum dicoccon* Schrank) cultivation is based on LR that show good agronomic performance and environmental adaptability and originated by continuous on-farm conservation. They are able to compete well with weeds and to exploit areas with poor soils, so that they can be cultivated in low-input agronomic systems. The morpho-physiological and genetic characterization of Farro from Monteleone di Spoleto has shown that this population is distinct from other LR and is composed of different genotypes (Fig. 3) (Barcaccia *et al.* 1998; Torricelli *et al.* 2002; Torricelli and Falcinelli 2007). In Monteleone area (Umbria Region) emmer is cultivated on about 120 hectares in farms generally smaller than 20 hectares. On average, the total production of 'Monteleone di Spoleto' emmer is assumed to be 180 t per year and half of this production comes from just one farm. The traditional use of emmer is the whole grain, used for soup dishes. However, product diversification developed in recent years has made it possible to increase income from emmer cultivation. Emmer is now processed in order to obtain flour, which allows farmers to produce and commercialize a wide variety of biscuits, cakes, pasta, flakes, soups and bread types (Torricelli *et al.* 2009). Local income from this LR can be estimated in 250,000 euro. Nowadays the 'Monteleone di Spoleto' emmer has undergone a successful economic invigoration thanks to some farmer initiatives. In October 2002 seven local farmers constituted themselves into the 'Association of Monteleone di Spoleto Emmer '. The Association, with the collaboration of the University of Perugia, of agriculture associations and of other local institutions, obtained the PDO (Protected Designation of Origin) quality mark (Torricelli *et al.* 2009). As for the examples mentioned above, the 'Monteleone di Spoleto' emmer is a good example of successful use of quality marks for the promotion of a product obtained from a LR.

Figure 3. Phenotypic variation of "Farro di Monteleone di Spoleto" LR (Photo: R. Torricelli).

Example 4 – Eataly: a high quality food commercial chain

Eataly is a food commercial chain specialized in selling quality Italian food. Those who love and the Italian food treasures can purchase a wide range of products at Eataly in Rome, Turin, Genoa and Milan big selling points (Fig. 4). In Rome over 14 thousand rigorously Italian products, some of which produced from LR (as well as from local breeds), are sold in the 17,000 square meter space. The structure is on four floors devoted to good Italian cuisine. For gourmets there are 23 restaurants or refreshment corners, 40 teaching areas, 8 rooms for courses and stands for the sale of products. On the shelves there is the best of wines, of quality extra virgin oil, of meats and cheeses, and of bread and pasta. This is the biggest pole of quality food products and excellent catering of 'made in Italy' food.

Such food commercial chains, of course, represent a mean to value products from Italian LR.

Figure 4. Building of Eataly in Rome, https://www.finedininglovers.com/stories/eataly-farinetti/ http://www.ilcervorampante.it/.

Example 5- "Fagiolina of Trasimeno Lake" cowpea LR

In Italy, cowpea cultivation is now restricted to a very limited acreage and is mostly based on LR. Both *Vigna unguiculata* subsp. *unguiculata* cv-gr. *Unguiculata* and cv-gr *Sesquipedalis* (Maréchal *et al.* 1978) are cultivated for seed and fresh pods (like French bean), respectively.

The LR of which we are reporting come from the Trasimeno Lake area in Umbria, central Italy, where the plant (locally called "fagiolina") has been grown for centuries, as it is shown by historical documents (Fig. 5).

The existing cowpea LR of "Fagiolina of Trasimeno Lake" were initially characterized for morphological, organoleptic and genetic traits and then reintroduced among a wider number of farmers (Polegri and Negri 2010). These activities led to an expansion of the LR cultivation and increased farmers' income. To encourage further LR cultivation a request for the Protected Designation of Origin (PDO) status has been promoted. The Fagiolina of Trasimeno Lake also caught the interest of the Slow Food movement which included it among its 'presidia', and, within a few years, it became a must in many top restaurants, even outside Umbria.

The initial promotion of research and of farmer awareness triggered a virtuous process of conservation. The area under cowpea cultivation increased which in turn significantly increased the income of the farmers who cultivated the crop. The market price for the small, white-seeded LR increased in the regional capital (Perugia) from 6 euro/kg in 1994 to the present 20-22 euro/kg. A 'Consortium' of Fagiolina growers was established in order to market the crop more effectively. Finally, some farmers have reintroduced the crop outside the Trasimeno Lake area (Polegri and Negri 2010).

Enhancing use through appropriate actions of research and market promotion can save LR from extinction.

Figure 5. Seed types of **"**Fagiolina del Trasimeno" LR.

Example 6 - ''Sedano Nero di Trevi'' celery LR

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. 6). 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 6. The ‘‘Sedano Nero’’ LR fair, http://www.protrevi.com/protrevi/sedano12.asp.

Example 7 - The “Pera Cocomerina” pear LR

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. 7). 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 7. Particular of the fruits of “Pera Cocomerina” LR, http://www.turismo.fc.it.

Example 8- "*Campagna Amica*" project of Coldiretti farmer organisation

"Campagna Amica" is a marketing project designed in 2009 by Coldiretti, one of the main Italian Farmer Organisation, in order to promote direct selling of local and seasonal food products by farmers. A brand has been created to allow consumers to find and identify food products associated with the values of authenticity, freshness and traceability. To succeed in its endeavour, Coldiretti employs its capillary network of members throughout the territory and its relations with local authorities to revitalize or establish a growing point of sales network farms, outdoor and indoor farmers markets, shops etc.. Moreover, it has reinforced these activities with synergic collateral projects related to rural tourism, the promotion of environmental friendly agriculture and urban-rural interactions (Mereatur and Lacourt, 2012).

The mark "*Campagna Amica*" identifies those places where it is possible to find Italian products guaranteed from farmers. *"Campagna Amica"* is the first National and European network of direct sales and has over 7,000 locations.

The logo (Fig. 8) ensures: i) 100% Italian agro-food products; ii) authenticity, transparency and typical food productions; iii) fresh and natural agro-food products; iv) traceability (Mereatur and Lacourt, 2012).

This campaign appears to be a useful mean to promote local economies based on nearby products obtained from LR.

Figure 8. The Logo of "*Campagna Amica"* campaign.

Example 9 - The traditional horticultural types

Urban and peri-urban gardens

These gardens are usually linked to urban centres of medieval origin and are often equipped with wells or cisterns. When irrigation water is not available, they are traditionally called "dry gardens". Located either inside or outside the city walls, they were frequently established on terraces or on the lands of destroyed houses. They thus represent, besides their agricultural interest, an important record of local history and urban planning (Fig. 10 A and 10 B)

Gardens of convents and noble mansions

Monasteries have always played an important role in the spread of both new crops and new agricultural techniques. Each convent, particularly the Benedictine convent, had its own garden for subsistence purposes. Often, next to the food crops, a "giardino dei semplici" was cultivated with medicinal plants and

aromatic herbs. The "San Francesco grape", for example, was introduced into the Peligna Valley (Abruzzo Region) when the Franciscan monks established the convent of San Antonio of Sulmona. The monastery gardens, and those of noble or wealthy families, were often interspersed with herbaceous crops and orchards, especially apples and pears, often from external sources (Fig. 9 C).

Presently many of these historical gardens are being/have been restored reintroducing LR.

Figure 9. A) Old gardens inside the medieval walls to Rocca S. Giovanni, Chieti (Abruzzo Region). B) Gardens near the medieval walls to Monterubbiano (Marche Region). C) Still cultivated gardens near the church of S. Apollinara (Aquila, Abruzzo Region). From Silveri and Manzi, 2007; Photos Alberto Manzi.

Home Gardens

Finally, many home gardens exist where LR belonging to a certain family are still cultivated (Negri 2003; Galluzzi *et al.* 2010). It is in these home gardens that new LR are continuously found. They are a precious reservoir of LR diversity, mostly unexplored, that deserve the highest attention.

Example 10 - "Solina di Abruzzo" wheat LR

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. 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 consortium consists of about 12 famers of the provinces

Aquila, Pescara and Chieti. The production of flour is both dedicated to own consumption and direct selling to consumers on the local markets, as such the "Solina di Abruzzo" LR is a nice example of both family and local market use. The flour is used to prepare bread and fresh artisanal home-made pasta (Silveri and Manzi 2007). The figure 10 shows a field of Solina, pasta, bread, spikes of Solina and logo of the Consortium.

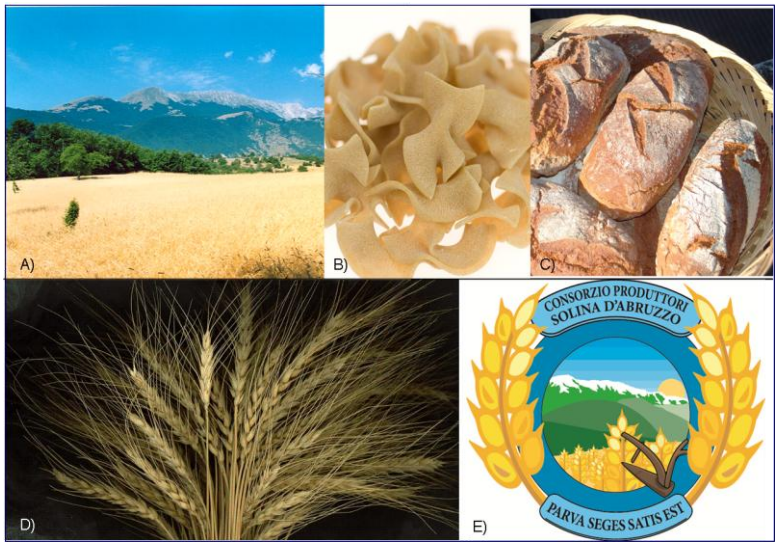

Figure 10. A) field of "Solina di Abruzzo" LR; B) home made pasta of Solina; C) bread of Solina; D) spikes of Solina; E) logo of the Consortium (Photos: Donato Silveri).

Example 11 - "Cuore Verde" a new lucerne variety for organic farming derived from a LR

"Cuore Verde" is broad-based variety and developed under organic conditions in central Italy. This is one of the first examples of organic plant breeding in Italy. The breeding program used a LR of *Medicago sativa* L. grown for about 15 years in organic farm in Spello (Umbria Region). A phenotypic selection was applied: 1600 plants of the LR were spaced transplanted in the experimental field (Fig. 11). The plants were phenotypically evaluated for two growing seasons for yield, growth score, flowering time, biotic and abiotic stresses resistance. 480 plants were selected for uniformity and all the others were eliminated. Seed produced by intercrossing was harvested. An equal amount of seeds for each of 480 selected plants was mixed and used to produce the first seeds of the variety (Falcinelli and Torricelli 2004).

Figure 11. Spaced LR plants under selection in the experimental field.

Example 12 "Community Seed House" (Community Seed Bank) for local farmers

Umbria Region recently designated 3A-PTA (3A – Agrofood Technology Park) as the subject responsible for the actuation of the Regional Act 25/01 "Protection of autochthonous genetic resources of agronomical interest". In this role, the company set up the Regional Register of Autochthonous Genetic Resources and provides for their *ex situ* and *in situ*/on-farm conservation. The Conservation and Safety Network, provided by the Regional Act and coordinated by 3A-PTA, is the principal tool to allow harmonizing *ex situ* and on-farm (*in situ*) conservation. In order to encourage on-farm conservation and to face the possibly emerging critical issues of a pilot "Community seed bank" was created inside an organic farm in cooperation with the University of Perugia (Dipartimento di Scienze Agrarie, Alimentari e Ambientali)(Fig. 12) (Concezzi *et al.* 2014). Germplasm collected by the University of Perugia in an Umbrian area around the Trasimeno Lake is multiplied in the University experimental field, then distributed to the farm which, in turn, distributes the seed to other nearby farmers interested in cultivating the LR.

Figure 12. The Trasimeno community seed house: demonstrative garden for reproducing bean and tomato seeds and part of the seed collection (Concezzi *et al.* 2014).