Report on the definitions of varieties in Europe, of local adaptation, and of varieties threatened by genetic erosion

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Report on the definitions of varieties in Europe, of local adaptation, and of varieties threatened by genetic erosion

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1 Introduction

1.1 – Presentation from the DoW

In this task the different (interpretations of the) definitions of concept of landraces, conservation varieties and amateur varieties among different stakeholders in different countries and/or regions will be mapped and investigated. Possibilities for marketing of other varieties not included in these specific seeds will also be mapped. This will be done by literature research, and through case studies of current practices, and through in depth surveys in 5 areas of Europe (NL, I, F, S, CH).
Task 1.1 will

- report on the "variability" of the local definitions and the matched habit or laws/regulations
- specify the concept of local adaptation
- specify the notion of varieties threatened by genetic erosion (with a historical approach, mentioning the genetic resources stocks, and analyses of their interest compared to the *in situ* variability)

1.2 – Elements from the deliverable D1.1 (methodology)

The idea is to cross the points of view and definitions of all stakeholders. So, most of the actors will be solicited. Several approaches will be performed:

- Introduction of a « participatory method » by a forum

A web forum has been proposed to get a broader participation and enlarge the points of view, mainly toward the users of cultivated biodiversity. Some elements from literature review will be brought to initiate the debate for all the concerned concepts.

- Literature review

Several scientific and experts will be contacted

- Analysis of surveys about European experiences (farmers, researchers …)

2 Context

2.1 The need of definitions

The starting point: is the reality of the cultivated plants in the European fields covered by the current seed regulations?

We already may consider the two groups of cultivated varieties corresponding to seed regulations:

- The varieties which fit for the registration in the European (Council Directive 2002/53/EC of 13 June 2002) and National catalogues
- The "conservation varieties" which are concerned by the new Directive (2008/62/CE).

- **The definition of the variety fitting to the catalogue registration is specified in several texts of regulation.**

Council Directive 2002/53/EC of 13 June 2002[1] on the common catalogue of varieties of agricultural plant species and Council Directive 2002/55/EC of 13 June 2002 on the marketing of vegetable seed lay down the legislative basis for the common catalogue of varieties of agricultural plant species (consolidated version of 12 June 2008) and the common catalogue of varieties of vegetable species (consolidated version of 18 June 2008). These catalogues are established on the basis of information received from the Member States and published in the Official Journal. They list those varieties whose seed is subject to no marketing restrictions within the Community as regards variety. **Varieties must meet standards, notably pertaining to distinctness, uniformity, stability and, in the case of agriculture, value for cultivation and use in order to be listed.** In the case of varieties of agricultural plant species, their satisfactory value for cultivation and use is based on yields, resistance to harmful organisms, behaviour with respect to factors in the physical environment and quality characteristics.

For the national catalogue, in France[2], the GNIS (Groupement National Interprofessionnel des Semences) gives some indications[3] about the cultivated variety suitable to the registration on the catalogue. The varieties answer to the needs of the farmer (i) who wish to grow seed or plants which represent a known potential for cultivation and (ii) who want to be assured to find the same potential as far as he will be using the variety.

Taking the above into account a variety can be defined as follows:

- an artificial population,

[1] http://ec.europa.eu/food/plant/propagation/catalogues/index_fr.htm
[2] Décret n° 81-605 du 18 mai 1981 pris pour l'application de la loi du 1er août 1905 sur la répression des fraudes en ce qui concerne le commerce des semences et plants.
[3] http://www.gnis-pedagogie.org/pages/selection/chap5/1.htm

- with a narrow genetic basis, even reduced to one genotype, in order to provide the genetical homogeneity to favour the agricultural practices and to allow the harvest of a homogenous product with a maximal yield and with well-defined characteristics,
- and which can be reproduced according to a fixed and registered scheme.

Such a variety could be the object of a Plant Variety Protection Certificate delivered by UPOV[4] (*International Union for the Protection of New varieties of Plants*).

The definition of a plant variety, which fits to registration and Protection Certificate, is specified in the UPOV Convention (Article 1(vi)) as:"a plant grouping within a single botanical taxon of the lowest known rank, which grouping, irrespective of whether the conditions for the grant of a breeder's right are fully met, can be

- defined by the expression of the characteristics resulting from a given genotype or combination of genotypes,

- distinguished from any other plant grouping by the expression of at least one of the said characteristics and

- considered as a unit with regard to its suitability for being propagated unchanged;"

This full definition clarifies that a variety must be recognizable by its characteristics, recognizably different from any other variety, and remains unchanged through the process of propagation. If a plant variety grouping does not meet these criteria, it is not considered to be a variety within the UPOV system. However, the definition also makes clear that this is irrespective of whether the conditions for the grant of a breeder's right are fully met and this is not, as such, a condition for determining if a variety is eligible for protection.

The most important point that is common and underlined in all these definitions is the stability: the variety has to be propagated unchanged, with a fixed and registered scheme.

The emergence of the "conservation variety" concept

The first mention of regulation about cultivated varieties is dated of the 1st August 1905 in France, and was issued by the "Répression des Fraudes". In 1942, the Permanent Technical Committee on Seeds (Comité Technique Permanent des Semences, CTPS), made up of seed industry representatives and government scientists, determined the DUS criteria for defining the varieties listed in the official French seed catalogue: Distinction, Uniformity and Stability. In 1966, the European Community created the Common Catalogue. Any commercialisation, whether free or for payment, is outlawed for the varieties not listed in the national or European catalogues. Moreover, only certified seed producers are allowed to sell seeds.
If the European catalogue counts about 20000 varieties, the European gene banks can offer more than one million[5] of accessions. Most of them represent samples of the varieties created in the European countryside before the generalization of the DUS varieties. Nowadays, besides the conventional agriculture, we observe the development of other agricultural

[4] (UPOV) INTERNATIONAL CONVENTION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS of December 2, 1961, as Revised at Geneva on November 10, 1972, on October 23, 1978, and on March 19, 1991

[5] Number of accessions which are available on EURISCO database

practices related to the diversification of public demands like organic farming and local products. These agricultural systems are based on varieties which cover a great variability of genetic status, and qualification, for which the stability and homogeneity criteria are not the intrinsic quality and which are not necessarily required. In 1998, for the first time, the European Directive 98/95/CE mentions the essentialness to ensure the conservation of genetic resources and the necessity to introduce a legal basis to that end to permit, within the framework of legislation on the seed trade, the conservation, by use *in situ*, of varieties threatened with genetic erosion. The last step was on 20 June 2008 with the **Directive 2008/62/CE "providing for certain derogations for acceptance of agricultural landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion and for marketing of seed and seed potatoes of those landraces and varieties".**

The new regulation about conservation varieties is accompanied with a set of definitions:

Chapter I: Subject matter and definitions

Article 1

Subject matter

1. As regards the agricultural species covered by Directives 66/401/EEC, 66/402/EEC, 2002/54/EC, 2002/56/EC and 2002/57/EC, this Directive lays down certain derogations, in relation to the conservation in situ and the sustainable use of plant genetic resources through growing and marketing:

(a) for acceptance for inclusion in the national catalogues of varieties of agricultural plant species, as provided for in Directive 2002/53/EC, of landraces and varieties which are naturally adapted to the local and regional conditions and threatened by genetic erosion, and

(b) for the marketing of seeds and seed potatoes of such landraces and varieties.

2. Unless otherwise provided in this Directive, Directives 66/401/EEC, 66/402/EEC, 2002/53/EC, 2002/54/EC, 2002/56/EC and 2002/57/EC shall apply.

Article 2

Definitions

For the purposes of this Directive the following definitions shall apply:

(a) "**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;

(b) "**genetic erosion**" means loss of genetic diversity between and within populations or varieties of the same species over time, or reduction of the genetic basis of a species due to human intervention or environmental change;

(c) "**landrace**" means a set of populations or clones of a plant species which are naturally adapted to the environmental conditions of their region;

(d) "**seed**" means seed and seed potatoes, unless seed potatoes are expressly excluded.

They will be discussed from several points of view within the diversity of the European countries to evaluate the applicability of the law and to determine the regulation scenarios which are necessary to take into account the "variety reality" in Europe. These scenarios will be proposed at the end of the Farm Seed Opportunities project.

- **What about the landraces?**

The text of the Chapter II gives the conditions of acceptation of landraces and how they become "conservation varieties" to fit for a seed regulation. For that they need to comply with some DUS characteristics. Farm Seed Opportunities aims is to measure to which extent it is

possible to register a landrace according to the new Directive 2008/62/EC from several points of view: species biology, genetic, agronomy, market, sociology, history, culture.

Chapter II: Acceptance of Conservation Varieties

Article 3

Conservation variety

Member States may accept the landraces and varieties referred to in Article 1(1)(a) subject to the requirements provided for in Articles 4 and 5. **Such a landrace or variety shall be referred to in the common catalogue of varieties of agricultural plant species as a "conservation variety".**

Article 4

Derogations concerning substantive requirements

1. In order to be accepted as a conservation variety, the landrace or variety referred to in Article 1(1)(a) shall present an interest for the conservation of plant genetic resources.

2. By way of derogation from Article 1(2) of Directive 2003/90/EC, Member States may adopt their own provisions as regards distinctness, stability and uniformity. In such cases **they shall ensure that for distinctness and stability** at least the characteristics shall apply which are referred to in:

(a) the technical questionnaires associated with the Guidelines of the Community Plant Variety Office (CPVO) listed in Annex I to Directive 2003/90/EC, which applies to that species, or

(b) the technical questionnaires of the Guidelines of the International Union for the protection of new varieties of plants (UPOV) listed in Annex II to Directive 2003/90/EC, which applies to that species.

For the assessment of uniformity, Directive 2003/90/EC shall apply. However, if the uniformity level is established on the basis of off-types, a population standard of 10 % and an acceptance probability of at least 90 % shall be applied.

The diversity of the approaches could be evaluated by the diversity of the translations of the word "landrace" in the member countries.

Table 1: Translation of the term "landraces" in the text of the 2008/62/CE regulation in the national versions

Country	Translation of the word "Landraces"	Re-translation in English	Point of view
France	Races primitives	Primitive, original or basic races	Historical, social or biological
Germany	Landsorten	Landraces	Historical, biological
Italy	Ecotipi	Ecotypes	Ecological
Spain	Variedades	Varieties	Biological
Romania	Soiurilor locale	Local variety	Geographical
Portugal	Variedades autoctones	Autochthonous varieties	Geographical and social
Hungary	Honos fajok	Home variety	Sociological
The Netherlands	Landrassen	Landraces	Historical, biological
Latvia	Savvaļas sugas	Wild species	Historical, social or biological

The French version is one the most original because the notion of « primitive races » does fit with the ideas of country and soil which are contained in the term “land”. The other countries have chosen between the two polarities of the concepts: (i) the cultural one, i.e. country, nation, home or (ii) the physical one, i.e. soil and area.
France has given a qualitative value with the term of “primitive”. Thus, French policy makers seemed to have given a position of these varieties compared to “advanced” varieties. We can also consider the difficulties of translation in another country as Latvia. According to a Latvian breeder, this is not a good Latvian translation of landrace. There is no exact translation for landraces in Latvian. But Latvian breeders and gene bank would use "vietējās šķirnes" - "Local varieties" or "tautas selekcijas šķirnes" - "national or folk bred varieties".

As soon as the first line of the regulation, we have detected differences between countries. We will try to bring other aspects of the European diversity in order to determine which type of varieties could be taken into account with the current regulations and which ones will be missing.

2.2 The studied concepts: varieties, local adaptation, genetic erosion

Variety

Let us have a look at a basic definition in an encyclopaedia or dictionary. Two examples[6] are following:

- *The American Heritage® Dictionary of the English Language, Fourth Edition copyright ©2000 by Houghton Mifflin Company. Updated in 2003. Published by Houghton Mifflin Company.*

  1. The quality or condition of being various or varied; diversity.
  2. A number or collection of varied things, especially of a particular group; an assortment: brought home a variety of snacks.
  3. A group that is distinguished from other groups by a specific characteristic or set of characteristics.
  4. Biology
  a. A taxonomic subdivision of a species consisting of naturally occurring or selectively bred populations or individuals that differ from the remainder of the species in certain minor characteristics.
  b. An organism, especially a plant, belonging to such a subdivision.
  5. A variety show.

[French variété, from Old French, from Latin variets, variett-, from varius, various.]

- *Collins Essential English Dictionary 2nd Edition 2006 © HarperCollins Publishers 2004, 2006*
  1. the state of being diverse or various
  2. different things of the same kind: I'm cooking the mince with a variety of vegetables
  3. a particular type of something in the same general category: this variety of pear is extremely juicy
  4. Taxonomy a race whose distinct characters do not justify classification as a separate species

[6] http://www.thefreedictionary.com/variety

> 5. a type of entertainment consisting of short unrelated acts, such as singing, dancing, and comedy [Latin varietas]

The word "variety" (variété, variedad…) designates at the same time the concept of "being diverse" and one form of this diversity when we considerer taxonomy aspects. This word becomes quite paradoxical when it named the "cultivated variety" which answers to the DUS characteristics of the catalogue. Therefore it represents the contrary of the diversity!
This paradoxical word meets all its ambiguities within the concept of "cultivated varieties" if we consider the diversity of the points of view.

Local adaptation

The notion of local adaptation is at the heart of the 2008/62/CE regulation as soon as the title: « **which are naturally adapted to the local and regional conditions".** In the text of the regulation, this concept evolves to another one: the region of origin.

Chapter II: Acceptance of Conservation Varieties

Article 8

Region of origin

1. When a Member State accepts a conservation variety, **it shall identify the region or regions in which the variety has historically been grown and to which it is naturally adapted, hereinafter referred to as region of origin**. It shall take into account information from plant genetic resource authorities or from organisations recognised for this purpose by the Member States.

Where the region of origin is located in more than one Member States, it shall be identified by all Member States concerned by common accord.

2. The Member State performing the identification of the region of origin shall notify the identified region to the Commission.

Article 9

Maintenance

Member States shall provide that a conservation variety must be maintained in its region of origin.

The adaptation of the plant recovers several notions from the biological, ecological and agronomical aspects. Nevertheless, the region of origin extends its understanding to geographical and cultural concepts.

Genetic erosion

- General definition

Genetic erosion: definition FAO[7]:

> "Loss of genetic diversity, in a particular location and over a particular period of time, including the loss of individual genes, and the loss of particular combinations of genes such as those manifested in landraces or varieties. It is thus a function of change of genetic diversity over time (FAO, 2002)

[7] FAO 2002. Monitoring the implementation of the Global Plan of Action for the conservation and sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Working paper CGRFA-9/02/07 presented to the Ninth Regular Session of the Commission on Genetic Resources for food and Agriculture, Rome, 14-18 October 2002. FAO, Rome, Italy. See http://www.fao.org/ag/cgrfa/docs9.htm.

- Definition in the text law (2008/62/CE)

"**genetic erosion**" means loss of genetic diversity between and within populations or varieties of the same species **over time**, or **reduction of the genetic basis** of a species due to human intervention or environmental change

In the text of the law, the genetic erosion is only considered for the cultivated species: between and within the varieties. The policy makers have recognised the two components of the phenomenon: time and space.

2.3 The points of view

Crop species have always been the basis of our culture: food, fiber, countryside, and now even fuel; in that sense all people are concerned by the plants from agriculture.

The concepts have necessarily several dimensions and decisions of the policy makers will have consequences at several levels (agronomical, ecological, sociological, economical and cultural). Considering the different points of view will give an interval of variation of the concepts and enable the policy maker to better measure the impact of one choice.

"The existence of genetic variation was a common understanding since time immemorial. However it was Darwin who linked variation with adaptation mechanisms, and replaced the concept of stasis with that of recurring sequences of dynamic change. Events, such as nucleotide substitution, intra- and inter- locus (i) recombination, unequal crossing-over, DNA sequence deletion and insertion, gene duplication, element transposition, etc., continue to generate variation. Variation accumulated in populations of wild as well as cultivated species is however different for different characters. Whereas variation for disease resistance is very high and in rapid progress that for adaptation to environmental factors or for characters involved in the domestication syndrome is rather limited, most probably as result of continued selective pressure. Genetic diversity is of fundamental importance for the continuity of life; as it enables populations and ecosystems to adapt and survive environmental changes. In spite of its importance genetic variation is today eroded at a rate that has no precedents. Surprisingly, whereas the problem of biodiversity loss has been taken very seriously in general terms, its foundation, genetic diversity, has been almost neglected. Even less appreciated is the link between genetic diversity and the need for its conservation to sustain agriculture and food security. The consequence of this misconception is that concerns have stimulated a series of international agreements and programmes, whose principles and guidelines are not fully coherent, interpretations are different, interdependent issues are not fully understood. Actions taken under one legal instrument can lead to negative consequences on issues addressed by others." Porceddu, E. (2001) Biodiversity: scientific aspects and political issues. Journal of Plant Pathology 83 (2 Special Issue): 63-74 2001

3 Definitions according to the points of view

The aim: showing the variability of the concepts according to the points of view. These definitions will help to understand which part of the variability is under seed regulations and which part is out of any kind of regulation.

3.1 Variability of the notion of variety

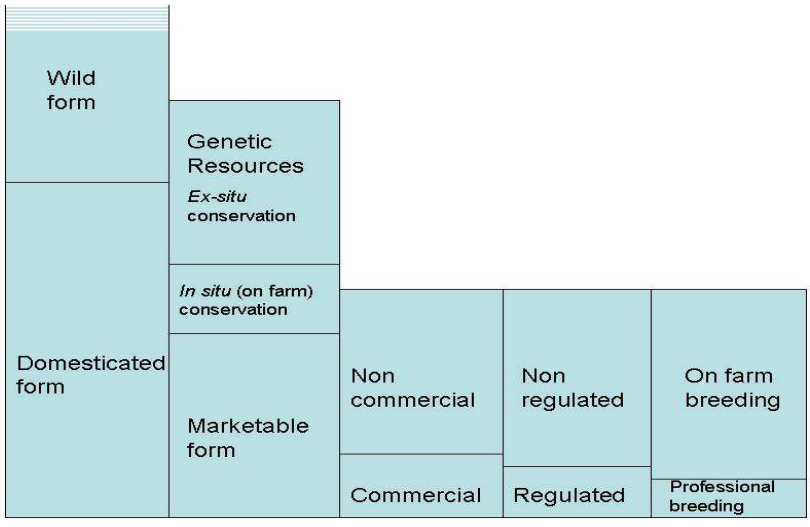
We have seen that, from a linguistic approach, "variety" could mean at the same time variation and a narrow piece of variation, thus at the same time a heterogeneous state and a homogeneous part of the heterogeneous set. Considering crop species, in a set named "variety", we meet all the situations from uniformity to heterogeneity.

3.1.1 From a practical points of view

From a practical point of view, plants, varieties, species can be described using several kinds of general qualification:

- Wild – cultivated
- Genetic resources – marketable
- Commercial – non commercial
- Regulated – non regulated
- Professional breeding – On farm breeding
- Conventional – non conventional

In this report we consider 'conventional' as commercial and regulated varieties derived from classical breeding (as thus not including GM-varieties). GM-varieties are often designated 'non conventional' varieties. They will not be considered in this report.



- **Wild vs cultivated varieties**

According to the Wikipedia source[8], "in biology, a species is one of the basic units of biological classification and a taxonomic rank. A species is often defined as a group of organisms capable of interbreeding and producing fertile offspring. While in many cases this definition is adequate, more precise or differing measures are often used, such as based on similarity of DNA or morphology. Presence of specific locally adapted traits may further subdivide species into subspecies."

Moreover it is precised that "no species concept yet proposed is entirely objective, or can be applied in all cases without resorting to judgment. Given the complexity of life, some have argued that such an objective definition is in all likelihood impossible, and biologists should settle for the most practical definition".

Variety
According to a botanical Approach (International Code of Botanical Nomenclature - ICBN): The term "variety" is a rank below that of species: As such, it gets a ternary name. A variety will have an appearance distinct from other varieties, but will hybridize freely with those other varieties (if brought into contact). Usually varieties will be geographically separate from each other. Varieties can be divided in subvarieties, which is the lowest rank.

Cultivar (**culti**vated **var**iety)
According to the International Code of Nomenclature for Cultivated Plants, the term "cultivar" designates an assemblage of plants that has been selected for a particular attribute or combination of attributes and that is clearly distinct, uniform and stable in its characteristics and that when propagated by appropriate means, retains those characteristics.

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Landrace vs. Cultivar vs. Variety
If "variety" is used in its botanical sense, the main difference between variety and landrace is that landrace refers to a population of domesticated lines of a plant species. If "variety" is considered as a legal term, the variety is registered and strictly defined and tested (DUS, for agricultural important species also VCU) and grants rights to its breeder, whereas landrace lacks formal breeding and is defined by historical origin while being genetically more diverse.

The term "variety" may refer to wild or domestic plants, while the term cultivar defines the domesticated varieties or landraces that are cultivated for human use.

- **Genetic resources – marketable varieties**

General definition of genetic resources: "genetic resources are genetic material of plants, animals or micro-organisms of value as a resource for future generations of humanity"[9].

For plants, a more precised definition is proposed: "Plant genetic resources of agriculture and horticultural crop are defined as propagating material of plants used in the past, present or with potential utilisation value including plants suitable for breeding purposes. The definition of plant genetic resources includes not only crops but also their wild relatives and wild

[8] http://en.wikipedia.org/wiki/species
[9] http://stats.oecd.org/glossary

plants."[10]

In these two definitions, genetic resources are seen as a potential for future generations or for breeding purpose, and there are not considered to have a marketable value.

Two strategies for conservation are generally considered:

Ex-situ conservation of genetic resources

"*Ex situ* (= off-site) conservation of germplasm takes place outside the natural habitat or outside the production system, in facilities specifically created for this purpose."[11]

The majority of cultivated plants are conserved in genebanks. The sample of seeds is designated as "an accession". Accessions are all original entries which are collected by professional gene banks or private variety collectors.

Accession
An accession is an entry in a genebank or variety collection with an identification number. If sufficient passport data are available for an accession the gene bank curator can trace back the source of origin (e.g. the traditional maintainer of this accession) or the geographic position where the accession was first sampled. From conservation varieties or landraces with the same name you can find often several accessions in gene banks. These may be duplicates from each other originating from an exchange between genebanks. However it is also possible that they originate from one variety or landrace which has been further bred in various localities. It is the curator's job to assess the similarities of these accessions and assess if they are true duplicates or if they originate from one source but are further bred. For breeders the existence of different accessions with the same name allows a first selection if they are looking for genetic material for their breeding programs or for marketing projects.

In situ conservation:

"*In situ* (=on-site) conservation (and use) refers to the maintenance and use of wild plant populations in the habitats where they naturally occur and have evolved without the help of human beings »[11]

This first definition is completed in the Convention on Biological Diversity (CBD) in which *in situ* conservation is defined as "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."

For the cultivated varieties, there is an intermediate situation between the "genetic resources status" and the "cultivated and marketable" ones, when the conservation is performed on farm. "In its maintenance of farming systems, on-farm conservation applies the principle of conservation and use to all three levels of biodiversity: ecosystem, species and genetic (intraspecific) diversity. In conserving the structure of the agroecosystem, with its different niches and the interactions among them, the evolutionary processes and environmental pressures that affect genetic diversity are maintained and this contributes to the overall health of the local environment". In developing countries, Bioversity International sustains programmes of on farm conservation. "Farmers benefit from the continued agricultural

[10] http://www.genres.de/genres_eng
[11] http://www.bioversityinternational.org/Themes/Agricultural_Ecosystems/index.asp

diversity and ecosystem health that these programmes support. Local crop resources can be the basis for initiatives to increase crop production or secure new marketing opportunities. By building development efforts on local resources and through the empowerment of farming communities, they can lead to sustainable livelihood improvement. Resource-poor farmers, in particular, may benefit if development initiatives are not based on external inputs that may be costly or inappropriate for marginal agroecosystems."[11]

Marketable varieties:

In the DoW of FarmSeedOpportunities, we have defined the word "marketing" as followed: "Marketing must here be understood as a general term that includes production, use, exchange and selling". The on farm conservation creates a market for local varieties which are considered for one part as genetic resources, and for another, they contribute to a local market for a niche agriculture. Therefore, by the development of the on farm conservation, the difference between genetic resources and marketable varieties becomes unclear.

- **Commercial – non commercial varieties**

Crop improvement and seed production were separated in the second half of the 19th century among different specialized actors (breeders, seed producers and seed conditioners). Since then, a market for the varieties and their seeds has been developed and regulated. This conception was parallel to the increased use of farm inputs and the industrialization of agriculture.

At the international level, one may thus distinguish (Louwaars 2007)

- The formal seed supply system delivers certified seed to farmers from regulated varieties. Plant breeding research activity is the basis of the formal seed sector.
- The farmers' seed supply system based on the recurrent production and selection of seeds alongside or as part of crop production. It began with the agricultural activities all over the world. Seed and the knowledge associated with them are closely linked and embedded in the community and are often closely associated with the community's identity.

Despite the efforts put into developing formal seed supply in developing countries over 50 years, at the global level farmer-produced seed remains by far the most important source of plants. But in Europe the situation is opposite where most of the seed was purchased.

Variety and seed regulatory frameworks and seed control institutions have been developed in most countries primarily to regulate the formal seed sector. Seed production in the formal seed supply systems of the region does not differ significantly from country to country. The informal seed supply system consists in farmer-managed seed production activities and is based on indigenous knowledge and local diffusion mechanisms. The quantities of seed exchanged in the informal seed supply systems are often very small compared to amounts traded in the formal sector. (FAO 2001)[12]

- **Regulated – non regulated varieties**

Under regulation we found the:

[12] FAO (2001) Seed production and improvement: assessment for the CEEC, CIS and other Countries in Transition. Proceedings of the Regional Technical Meeting on Seed Policy and Programmes for the Central and Eastern European Countries, Commonwealth of Independent States and other Countries in Transition, Budapest, Hungary, 6 - 10 March 2001, retrieved from

Variety – cultivar: Council Directive 2002/53/EC, UPOV with registration and protection
Conservation variety: Directive 2008/62/CE
Both directives were previously mentioned in Chapter 2.

Amateur variety (in France): « arrêté du 26 décembre 1997 »
"Amateur varieties" are varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions. Only, France proposed a catalogue for this type of varieties.

The origin Amateur varieties are either existing landraces varieties or newly developed based on the genetic material of older landraces.
The agronomic use: Amateur varieties are varieties developed for growing under particular local conditions and low input farming systems (organic farming).
The breeding process: Amateur varieties are bred on the field with simple traditional techniques.
The market: Amateur varieties are developed to meet the needs of localised markets and restricted quantity at the national level is enabled. They are mainly destined for non-commercial gardening; some exceptions exist in France for professional uses.
The legal approach: Amateur varieties will be also exempted from DUS, VCU tests under certain conditions.

- **Professional breeding – On farm breeding varieties**

Variety type obtained or multiplied by the professional breeders:

Several kinds of varieties were defined according to the mating systems of the species and the breeding methods of the variety:

- **Pure line**: genetically homogeneous; the variety can be reproduced unchanged;

- **F1 hybrid variety**: results from a cross between two inbred lines;

- **Clone**: results from the vegetative propagation; all the plants are strictly identical (case of potatoes and ornamental species);

- **Synthetic**: results from the controlled reproduction of limited number of plants or clones (case of the majority of the forage);

- **Open pollinated, population variety:** often, they are traditional varieties bred by rural communities; most of them were maintained with a low level of homogeneity; some of them are still multiplied by seed companies, notably for varieties of forages or vegetables which belong to the public domain.

On farm breeding varieties

Landraces:
Definition of landrace based on different approaches: (definitions given by the consortium)
The origin: A landrace is an autochthonous crop that is historically grown in a defined region. It is an open pollinated population of a domesticated plant species with a distinct phenotype
The agronomic use: A landrace is adapted to the regional environmental conditions with a capacity to tolerate biotic and abiotic stress, displaying relative yield stability.

They perform generally poorly under intensive cultivation but have an intermediate yield level in a low input agricultural system.
The breeding approach: A landrace is related to traditional farming systems lacking formal breeding improvement techniques. It is a population variety encompassing a wide range of nearly related lines, which has much genetic potential to adapt to specific environments.

Variety developed by the farmers or "Peasant" variety
The origin: Peasant varieties are varieties or landraces as product of peasant activity in a defined country or region, thus they have a value as "future" cultural heritage of farmers.
The agronomic use: Peasant varieties are adapted to the specific use or local conditions of the farmers who developed them.
The breeding approach: Peasant varieties are varieties developed in actual farming systems lacking formal breeding improvement techniques. The breeding methods only use the natural means of multiplication of the plants. The basis (parent lines) can be either old landraces and conservation varieties or outdated, not anymore protected varieties.

Other names and theirs origins for varieties conserved or bred by the farmers:
1. Farmers' new variety: a variety developed by farmers – often in collaboration with trained breeders which is sufficiently uniform to be called a variety. Such varieties are commonly selected for a particular region or a particular use, and often will not perform well enough in national coordinated variety trials to be identified as an improvement (statistically speaking) over the available varieties.
2. New landraces: genetically heterogeneous varieties that have developed from landraces outside their original region, and which have (recently) developed distinctive characteristics in their new agro-ecological environment either through natural and farmers' selection or by these forces complemented by breeder's involvement (in participatory breeding).
3. Old varieties: varieties which have once been on the national list but which were removed because the new varieties had turned it obsolete in traditional agriculture. Such varieties are often not maintained anymore by the original breeder. Such varieties may be valued again for specific purposes (e.g. baking quality for northern European eco-farming of wheat) and would require a new maintainer and a reintroduction on the national variety list.

Case of "heirloom"
Heirloom as definition is related to the words inheritance or heritage as passed from generation to generation as cultural property. Although this term may have a marketing function potential, we suggest that its use due to clarity reasons could be omitted in this project. Instead, we propose the use of the term "landrace" as it encompasses the meaning of heirloom varieties.
Heirloom varieties are old and open-pollinated varieties (i.e. they pollinate naturally) and usually bred true-to-type. The word "heirloom" is used to point out the historical interest. These varieties are generally 50 to 100 years old, although many are much older. Heirloom vegetables are vintage varieties which have been preserved by passing seed down from generation to generation, and sometimes for centuries.

3.1.2 The varieties qualified by the users, example in European countries

- **In Spain:**

A questionnaire has tried to gather all the designations of the varieties which could fit to landraces, local varieties, conservation or amateur varieties. Most of the stakeholders (research, market, farmer, association…) were interviewed.
The most frequently used terms obtained from 23 persons who have answered this question, and the number of person who have mentioned each term:

"Variedades locales": Local varieties. 20 persons.
"Variedades tradicionales": Traditional varieties. 18 persons.
"Variedades autóctonas": Autochthonous varieties. 15 persons.
"Variedades de conservación": Conservation varieties. 7 persons.
"Variedades antiguas": Antique varieties. 7 persons
"Variedades campesinas": Peasant varieties. 4 persons
"Cultivares": Cultivars. 3 persons.
"Variedad del país": Country varieties. 3 persons.
"Variedad de la tierra": Land varieties. 2 persons
"Variedades indígenas": Indigenous varieties. 2 persons.

Other terms: "Semilla local" (local seed), "semilla de aquí" (from here varieties), "semilla campesina" (peasant seed), "variedades del lugar" (regional varieties), "cultivar local" (local cultivar), "población del país" (country population), variedades población (population varieties), "variedades del terreno" (field varieties) , "variedades vernáculas" (vernacular varieties), "variedades viejas" (old varieties), "recursos fitogenéticos domésticos" (domestic plant resources), "variedades ancestrales" (ancestral varieties), "cultivar local" (local cultivar), "recurso genético" (genetic resource), "variedades de siempre, las de toda la vida" (same old, since forever varieties).

For the terms the most frequently used, some precisions had been given by the interviewed persons:

- "Variedades locales" (local varieties). Term which make reference to location. Varieties of very local distribution, this term includes those varieties which come from another place but which have adapted to an area and also original autochthonous varieties. These varieties have close ties to land and to farmers. Nevertheless this term is little used by farmers.
- "Variedades tradicionales" (tradicional varieties). Term which makes reference to history. It is related to consumers and to the society where they have been created. Varieties which come from the heritage of previous generations and which have been used for a long time.
- "Variedades autóctonas" (autochthonous varieties). Term which makes reference to primary origin. Varieties originated where they are actually cultivated. This term includes the varieties result of the domestication of wild species or result of the genetic introgression in these last varieties.
- "Variedades de conservación" (conservation varieties). Term which makes reference to legal figure. Varieties which are important to preserve as they could be lost in modern society, which is characterized by the lost of traditions and diversity and by the adoption of what market imposes.
- "Variedades campesinas" (peasant varieties). Term which makes reference to those people who preserve these varieties. Varieties produced by farmers. This term value the essential work of farmers for the existence of these varieties.

- "Cultivares" (cultivars). Botanical term.
- "Variedad del país" (country varieties). Term used by farmers.
- "Recurso genético" (genetic resource). Term used by technicians. There is a direct relationship between this term and the local varieties, although genetic resource access has less information, and it could happens that similar access have different denominations.

In France

The designation of the varieties varies according to the aim, the organisation, the origin of the varieties, as it could be illustrated by some examples in the following table:

Table 2: Some examples of the designation of conserved or improved varieties, in local experiences, and their market.

Species/region	Designation of the varieties by the users	Market	Type of varieties	Breeding organisation
Wheat (for bread)/South east	« Variétés anciennes »	Niche market, project of protection	populations	conservation
Wheat (for bread)/Brittany	« variétés paysannes »	Local development of organic or small scale agricultures	populations	PPB* and farm breeding
Cereals/South West	"variétés anciennes", "variétés paysannes"	Local market	Populations	Conservation, breeding
Maize/South West	Organic varieties, "variétés rustiques"	Development of organic or low-input agricultures, and all sorts of markets	Populations or composite varieties	PPB, small scale breeder and farm breeding
Tomato/South east	Organic varieties	Local market	lines	PPB
Cauliflower/Brittany	Organic varieties	All sorts of markets	populations	PPB

* PPB: Participatory Plant Breeding

The designation of the varieties is the reflection of several aspects of the farmers' experiences. When the main aim is the conservation of a patrimony, the term "ancient" is preferred. But, this time, French farmers involved in seed production began for a technical or economical reason, mainly to help the development of organic or low input agriculture. In this case, the selection is often performed in the framework of participatory plant breeding programmes with researches. The created varieties have taken the names of "variétés rustiques", "variétés paysannes" or organic varieties.

In Switzerland

The Swiss agricultural policy on varieties and propagating material is one of the first to have introduced a derogation clause that allows the commercialisation of non- certified propagating material and non-registered varieties in a national catalogue. In 1999, the list contained 60 landraces of cereals and about 70 landraces of potatoes. Requirements for derogation are quite simple: the demand must be accompanied by basic information about the applicant and the variety. Registration, for the time being, is free (Toledo 2002).

According to the « Report on the Implementation of the Global Plan of Action of the FAO in Switzerland » (published by the Federal Office of Economic Affairs, 1997), a landrace is defined as a spectrum of different genotypes (populations) of one variety, emanated of natural selection in the frame of traditional agriculture. The synonyms of landraces which are in use are "traditional variety" or peasant/farm variety" (in German "Hofsorte").

- **In the Netherlands**

In the Netherlands there is not a clear systematic on the use of terms for type of varieties related to conservation varieties. The acknowledged Dutch scientific name for landraces is 'landrassen', but the public will better understand the term 'streekrassen' (meaning regional or local varieties) or 'oude rassen' and 'historische rassen' (meaning old and historical varieties). When applying the term 'old' or 'historical' variety both once-registered-but-currently-removed-from-the-variety-list and non/(never)-registered varieties can be included. Nowadays the public is attracted by the word 'vergeten gewassen' (meaning forgotten or old fashion crop species) such as spelt or emmer, or 'vergeten rassen' (meaning forgotten varieties, but usually indicating local and old varieties. Such crops or varieties are grown and shown to the public in the museum gardens of e.g. a castle, but are also more and more for sale in specialised groceries or high-quality restaurants. The public is than triggered by ancient variety names indicating the origin of a certain province or village, such as the wheat variety 'Zeeuwse Witte'. Not so much among cereals but more clearly among vegetable crops such as cabbage or onion, we know many 'tuinders selecties' (meaning farmers/growers' selections), which will currently officially be indicated as a selection from an umbrella variety, such as 'Langedijker Bewaar' or 'Rijnsburger'. For arable crops one will use the word 'boerenrassen' but that will also include a kind of negative suggestion that such a variety is very divers and very variable. All of those above mentioned names will include non-hybrid, open pollinating varieties

- **In Italy**

There are still many farmers that grow their own varieties, which have a sort of historical tradition and also an increasing market. That is the reason why their regional laws and also their governmental position on this issue have always protected the link between a variety and its territory, narrowing its production to the area of origin. In that way they would like to protect farmers' communities, which still use and reproduce these varieties, from misappropriation. This is also one aim of their regional catalogue. But they are talking of local varieties or traditional varieties, the term "conservation varieties" is only used by officials. And there is no connection to new varieties (e.g. farmers' or peasants' varieties).

- **In Romania**

In Romania, the political history of the agriculture of the 20th century has greatly conditioned the situation of the varieties which can be defined as local varieties. About 90% of the agricultural surface belongs to the state, with an industrial agriculture. The small scale agriculture represents 9% of the area where some local varieties are traditional and threatened by the ageing of the rural populations who have maintained them until now. Generally; the diffusion of the products is difficult because they are not known by the consumers. Most of the local varieties are now in the genebanks and mainly those of Suceava, where they are conserved and described.
The threaten for local varieties in Romania have several reasons: (i) the farmer prefers the productivity of the new varieties, (ii) the small scale farming have financial difficulties, (iii) the farmers are aging, 80% are older than 60.
Moreover, the regulation 1366/29.12.2005 from the agricultural ministry imposes the catalogue and the DUS criteria for the cultivated species in the country.

3.2 Local adaptation

- **From a breeding point of view**

André Gallais, professor of Quantitative Genetic and Plant Breeding, proposes a definition of his discipline (Gallais, 2004): "**Plant breeding** can be defined as **the voluntary modification** of the plants by the man in order to adapt them to his needs. Thus, it can be clearly distinguished from **domestication** which can be defined as an adaptation of the plants to the culture by man, but the breeding is **thoughtless**. From a genetic point of view, it represents all the actions which allow the evolution of a group of individuals (without the expected qualities, at the desired level) to another group, more reproductible, providing progress. That means to bring together the maximum of favourable genes in the same individual"

Michel Chauvet, agronomist and ethnobotanist, is more questioning[13]: "**But precisely, all that was it done consciously or unconsciously? What are the role of the man and the role of the nature**? This question has great consequences during the international debates. The following elements may help us to answer: some phenomena occur quite unconsciously, for example, the gene exchanges in neighbourhood of wild and cultivated plants, or when plants adapt to climate. Other selections, as much unconscious, are the fact of the men when he used some cultivation or harvesting techniques. And then, there is the "eyes of the peasant, of the horticulturist."

And the same arguing was also found in the definition of the landraces:

> Remind the one of the directive 2008/62/EC from June 20th 2008: "'Landrace' means a set of populations or clones of a plant species which are naturally adapted to the environmental conditions of their regions." In this definition, man action is not mentioned.

Meanwhile, the Task force on On-farm conservation proposed[14] another definition with both nature and man actions, combining other definitions, and reported by Negri (2008)[15]:

"A landrace of a seed-propagated crop can be defined as
- a variable population, which is identifiable and usually has a local name,
- lacks "formal" crop improvement,
- is characterized by a specific adaptation to the environmental conditions of the area of cultivation (tolerant to the biotic and abiotic stresses of that area),
- and is associated with the traditional uses, knowledge, habits, dialects, and celebrations of the people who developed and continue to grow it".

From an historical point of view

This chapter tries to consider the concept in the light of crop species history. An example will illustrate the nature and the evolution of the cultivated plants, for the notion of local variety and the local adaptation.

The history of the cauliflower helps to put into perspective the concept of local varieties.

- The differentiation of broccoli and cauliflower

It seems that broccoli and cauliflower probably came from the same gene pools (Giles 1941; Gray 1989). Sprouting broccoli was described by Pliny in the first century and, according to the botanist Dodoens (16th century), cauliflower and broccoli would have been known for

[13] Forums agrosciences et société, cycle "histoire de..." du voyage des plantes à la mondialisation des espèces cultivées, conférence du 29 novembre 2001
[14] Second Meeting, at their meeting 19-20 June 2006, Stegelitz in Germany
[15] "Conservation varieties: a review of definitions", V Negri, "Farm Seed Opportunities" Villamartin, Nov 4th 2008

1500-2000 years. For a long time, the term “broccoli” designated several forms of plant, mainly the flowering stem of many *Brassica* species. The term became more specific with “sprouting broccoli”, the “calabrese” and also the biennial form of white cauliflower in Great Britain and Brittany during the 19th and 20th centuries. Nevertheless, until now, it designates several forms of plant from the botanical and commercial points of view. The classification became stabilised with registration in the official catalogue of varieties for a policy-maker and breeder points of view but in the countryside and in the gardener literature, it keeps all its meanings.

- Two centres of differentiation for cauliflower in Europe

Two main centres of diversification were then described for cauliflower by Allen et al. 1986: (i) Northern Europe with annual white type and (ii) Italy with more diversified forms and colours, with annual to biennial cycles. Until the 18th century at least, Cyprus, Malta and then Italy and Sicily were important for the seed production for all the farmers of the North-West of Europe, unable to produce their seed themselves, except for the Northern annual type of cauliflower which produce its curd in summer and has time to mature its seed before the frost.

- The adaptation of the winter type in West part of Europe

The undefined “broccoli-cauliflower group” were thus imported to Great Britain in this period (Gray 1989). Winter cauliflowers of the West part of Europe would derive from Italian form of broccoli imported in England, three centuries ago, and had been combined with autumn cauliflowers. In Cornwall (Great Britain), the climate and the soil were favorable. In Brittany (France), the region on the other side of the Channel, from the Cornwall pool the farmers from the Léon region in Brittany created Roscoff cauliflower, name of a town in the Léon (North of Brittany) which proved successful thanks to its high quality. In just a few decades, since the end of 19th century, farmers succeeded in extending the original January-March production period to the longer November-June harvest; from the initial exposed yellow heads, they succeeded in selecting whiter, denser heads covered with leaves, thereby modifying the quality standards. The same process of local adaptation of this winter pool was performed in the Pays de Loire and gave the Angers type and in the South of France with ‘Pascalin du Midi’.

- The development of the conventional agriculture and the extension of the market

However, a series of economic and technical upheavals led to a reduction in the importance of local heritage, created by the farmer plant breeding, in favour of mass production, with the professional varieties. Developments in communications opened up the national and then international markets to farmers in the region, markets which created the Roscoff value and recognize the “Roscoff” origin. With the advent of mechanization, associated crops were abandoned. Chemical fertilizers replaced kelp and heritage varieties were replaced by uniformed and standardized F1 hybrid varieties.

- The new episode of the cauliflower story

Nowadays, the organic farmers in Brittany have developed biodiversity as during the Italian, period with the numerous forms and color richness in the cauliflowers, using the genetic resources stored in England’s genebank. At this beginning of the 21st century, organic farmers have found an interest in the colors and variability of the curd form for their specific markets. The Brittany soil and climate still offer good development conditions to the cauliflowers previously grown in Italy. One century later the Roscoff cauliflower adventure, the Italian cauliflowers come back via England for a new episode of the cauliflower story.

Thus the history of the species shows frequent exchanges and transportations of cultivated

forms of *B. oleracea*, which nowadays offer a great available variability, conserved mainly in genetic resource centres. They never had individual name, only the name of the month of production, and the name of the farmer when seeds were exchanged. Some of them (220) were stored at INRA, in 1983, as a "stop on picture" in the evolution of the cultivated biodiversity. If we had stopped the "film" one century earlier, we would not find cauliflower but parsnips, forgotten by everybody, and asleep in the freezer in England where the production survives in the 20th century…

The stories of cultivated plants have fascinated several authors as De Candolle in 19th century and Vavilov at the beginning of the 20th century. Their interest was to discover the origin and travels of the cultivated plants. The cultivated plants have always accompanied the men in their movements and cultural evolution. **Thus the notion of local adaptation considers only a short period of time, at the scale of the history of the mankind.**

- **From a evolutionary and genetic point of view**

We have seen that the local adaptation is a relative notion whether we consider an historical point of view. Now, local adaptation, arising from spatial or temporal heterogeneity of selection, is a key phenomenon in several important fields of evolutionary biology (Porcher et al. 2004, Rieseberg et al., 2002; Merila¨ and Crnokrak, 2001; McKay and Latta, 2002) and in the evolution of the plants at the genetic level.
For the wild species, several studies have revealed that the differentiation at polygenic traits is, in most cases, significantly larger than that at neutral markers, suggesting a predominant role of local selection in natural conditions (Porcher et al 2004). An example is studied by Watson-Jones et al (2006): "Three species of *Brassica* (*B. nigra*, *B. oleracea*, *B. rapa*) found wild in the UK were assessed for levels of genetic diversity using AFLP. The relationship between genetic distribution and ecogeographic distribution was considered for each species to determine patterns that may be useful in formulating conservation strategies. Genetic distance between populations of *B. nigra* and *B. rapa* were correlated to geographic distance. Levels of genetic polymorphism in *B. oleracea* were correlated to soil pH while in *B. rapa* they were correlated to soil coarseness." The authors concluded about the conservation of the genetic resources and emphasized the interest in *in situ* conservation of a selection of disparate populations to keep all the characters of local adaptation.

The phenotypic and genetic evolution involved in the phenomenon of adaptation could be very rapid. The evolution of some genes involved in the adaptative response, and their corresponding phenotypes, had been recently studied for wheat during twelve years. They were experimented for their response to the environmental constraints. The allelic evolution and the emergence of new alleles and new haplotypes by mutation, recombination or migration, observed in the case of climatic adaptation in experimental wheat populations is probably a general mechanism involved in the adaptation to new environment of cultivated species (Rhone et al 2008).
When we consider cultivated species, in the framework of traditional farming systems, the adaptation is at the same time the results of the environmental effects and of the selection by the farmers. The case of maize was well studied in the region of Mexico. The farmer practice aim to select seeds based on the ears characteristics but nevertheless, their know-how favoured the more productive genotypes for the region's growing conditions (Louette and Smale, 2000).

- **Adaptation: mechanisms according to the paradigms in plant breeding**

It is widely acknowledged that the origin of plant breeding traces back to the beginnings of

agriculture and the domestication of plants. As we mentioned previously, it is currently thought that variability occurred by mutation and that, for many centuries, the conscious and unconscious selecting by farmers, along with selective pressures imposed by the temporal and spatial heterogeneity of growing conditions, resulted in landraces. Several authors are convinced that this process of crop improvement by farmers' selection is a very slow process compared with science-based professional plant breeding (Koorneef and Stam, 2001).

A first change of plant breeding paradigm occurred in the 20th century when it moved from selection of phenotypes toward "selection of genes". Plant breeders have tried to optimize the use of genetic variation and to bring together the best alleles to maximize yields, quality traits and resistance to biotic or abiotic stress … Their efforts to understand the interaction between genes, organs and environmental factors led to consider regulation mechanisms which opened a new way of understanding the heritable characters. The DNA sequence is not the single factor to determine the plant phenotype; plants characters are also influenced by the epigenetic state of the molecule. The epigenetic mechanisms, involving chromatin structure, cytosine methylation, small RNA…, can generate novel and heritable phenotypic variations by influencing gene expression. The new paradigm of plant breeding consists in the concomitant management of genetic and epigenetic inheritance. Because a plant's reproductive cell lineage is derived from somatic tissue late in development, genomic changes that occur during a plant's lifecycle can be transmitted to its progeny (Lukens and Shuhua, 2007). The diversity induced by cytosine methylation is more frequent than DNA mutation. The pattern of methylation could be very different from one cultivar to another for one species but can remain stable within the same cultivar when breeder takes care in the process of maintenance of one variety. Taking into account the environmental and genetic stimuli can affect the subsequent generations, the hypothesis of a slow evolution of the plants under farmer's selection has no more genetic basis.

3.3 Genetic erosion

Agenda21 (chapter15) states that "the current decline in biodiversity is largely the result of human activity and represents a serious threat to human development"

Basic definition

The notion of genetic erosion takes only into account the DNA sequence, at the basis of the genetic code. The first definition (given in §2.2) is completed by the one found in Wikipedia encyclopedia[16] :

> "Genetic erosion is the loss of genetic diversity, including the loss of individual genes, and the loss of particular combinants of genes (or gene complexes) such as those manifested in locally adapted landraces. The term genetic erosion is sometimes used in a narrow sense, such as for the loss of alleles or genes, as well as more broadly, referring to the loss of varieties or even species. The major driving forces behind genetic erosion in crops are: variety replacement, land clearing, overexploitation of species, population pressure, environmental degradation, overgrazing, policy and changing agricultural systems. The main factor, however, is the replacement of local varieties by high yielding or exotic varieties or species. A large number of varieties can also often be dramatically reduced when commercial varieties (including GMOs) are introduced into traditional farming systems. Many researchers believe that the main problem related to agro-

[16] Retrieved from Wikipedia: http://en.wikipedia.org/wiki/Agricultural_biodiversity

ecosystem management is the general tendency towards genetic and ecological uniformity imposed by the development of modern agriculture".

- **An evolutionary point of view**

The level and structure of genetic diversity in plant species – whether wild or cultivated – is shaped by the several evolutionary genetic forces of mutation, recombination, migration, genetic drift and selection (natural or artificial) and several epigenetic mechanisms (chromatin structure modificaton, DNA methylation, transposon activation, small RNAs regulation …). There are in turn affected by the interaction of the plants with humans and with their environment (biotic and physical) and by the reproductive biology of the species, through the intermediary of the differential survival and isolation of individuals and populations.

At the DNA sequence level, genetic diversity is always changing, but the report on the State of the World's Plant genetic Resources (FAO1998) summarizing country reports, suggests that 'recent losses of diversity' have been large, and that the process of "erosion" continues. It points out that, while loss of individual alleles is of particular concern, loss of gene complexes and unique combinations of genes (as in different landraces) can also have important consequences. *Genetic erosion may thus be defined as a permanent reduction in richness or evenness of common local alleles or the loss of combination of alleles over time in a defined area*. This definition recognizes that diversity has two components, namely (i) the number of different entities, and (ii) their relative frequencies. It also suggests that it is specifically loss of locally adapted alleles that is most significant. Genetic erosion will be detrimental to the short term viability of individuals and populations, the evolutionary potential of populations and species, and the direct use of genetic resources (Brown et al, 1997, in Maxted and Guarino, 2004).

Thus, both concepts « local adaptation » and « genetic erosion » appear to be negatively correlated. The landraces cultivated in traditional farming systems should not be considered as a separate entity, but rather as an open genetic system. Some researchers have compared the functioning of landrace system with the concept of metapopulation established for the wild species. A metapopulation is composed of subpopulations linked though patterns of dispersal and gene flow. Declines and extinctions of some subpopulations are demographically offset by immigration from others; genetic variation and exchanges occurs to favour the adaptation of the subpopulations. Arguments in favour of migration between populations also come from the "Shifting Balance Theory" of Wright (1931, 1982). This predicts that populations will evolve until they reach the nearest adaptive peak of the fitness surface (known as "adaptive landscape") and then will not be able to evolve to a better combination of favourable genes since this would involve crossing a maladaptive valley. Such crosses would be possible owing to changes in allele frequencies in the population after a bottleneck event or with migration from the other populations. To be efficient, the farm selection needs exchanges and renewal of diversity. In the case of maize landrace in Mexico area, "farmers exchange, pool or replace seed for several reasons, including seed loss due to poor harvests or insect damage in storage. A principal reason, however, is the belief that the same seed should not be planted in the same field over successive seasons because its yield will decline." This concepts of a "tired" variety and the need to renew through exchange has been reported for others crops and regions (Louette and Smale 2000, Pressoir and Berthault 2004). Almekinders et al. (1994) noted that farmers gave their "tired" seed to farmers in cooler and more fertile areas for multiplication in developing countries. In France, when the tradition was alive, the farmers from the plain used to multiply sometimes their wheat in the mountain areas to "awaken" it.

- **A practical point of view: how to measure**

The convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture all recognize the need for more systematic conservation action and a better assessment of threats to biodiversity.
Change is however, universal and natural, and there is therefore a need to distinguish anthropogenic changes that are detrimental to populations from the normal background levels of change. (Maxted and Guarino 2004)

- the case of wild plant:

The chapter 40 of the AGENDA 21 as the new agenda for the 21st century demands the development and use of measuring tools or evaluation criteria for checking whether national and international development processes fulfil the goal of sustainable use. Within the FAO, experts are working on the development of indicators for a world-wide monitoring of genetic diversity and genetic erosion. The World Information and Early Warning System on Plant Genetic Resources (WIEWS) can play an important role in this development. Indicators for monitoring of the realisation of the Global Plan of Action for Plant Genetic Resources in Food and Agriculture are also being discussed.
Because of the complexity of biodiversity, incomplete taxonomic knowledge and high cost of biodiversity assessments and monitoring programmes, monitoring will typically rely on a small number of indicators, for which data are available.[17]

- the case of cultivated varieties

No complete inventories of cultivated landraces (LRs) exist in every EU regions. In absence of these inventories it is impossible to estimate any risk at all (Porfiri et al. 2008).
A model concerning how to evaluate the risk of loss of different LRs has been proposed by ARSIAL Technical Committee[18] in Italy.
The committee initially recognised that:

- A changing socio-economic environment is the main cause of genetic erosion (i.e. increasing rate of farming drop-out, farmer ageing, unwillingness of young generations to reproduce seeds in the farm, insufficient information exchange, increasing use of modern varieties).
- Some of the genetic resources that were signalled as autochthonous to the committee serve a niche or a wider market locally, since typical products are highly appreciated in Italy.
- In some cases they are also available on the seed market (i.e. some horticultural crops and fruit trees).
- The biological traits and cultivation conditions of different species (type of reproductive systems, propagation type, agronomic density of plants etc.) were also taken into account.

Five main indicators have been chosen (i.e. parameters to be considered for each landrace):

A. existence of the product on the market;
B. presence of a landrace on the catalogues of seed companies or nurseries;
C. numbers of farmers still cultivating the landrace;
D. cultivated areas of the landrace in comparison with the total regional areas under that crop;
E. trend of new cultivation areas dedicated to that specific landrace

[17] http://www.cbd.int/indicators
[18] ARSIAL Techn. Committee (1 for the implementation of the Lazio Regional Law for the safeguard of agrobiodiversity (LR march 1st 2000, n15).

Each indicator is associated to other conditions so to attribute a risk score (1 = low; 2 = medium; 3 = high). The sum of different values for each indicator gives total level of erosion, with the following classification of the erosion risk:

low risk as total value ≤ 9
medium risk as total value 10÷13;
high risk as total value ≥ 14.

However, the presence of only one indicator with a score equal to 3 was sufficient to consider the landrace as under threat. (Porfiri, 2008)

4 Discussion

4.1 – Domain of definition of each term

The considered notions (variety, adaptation, genetic erosion) all cover a continuum of definitions and situations. The variety may present all the situations between the strict homogeneity (e.g.clone) to the heterogeneity (e.g. open pollinated landraces).

For this concept of "variety", the diversity is described by specific values in the regulations. Two characters may be taken as an example: homogeneity and stability. The policy maker has notified thresholds in this continuum to define the domain of applicability of the regulation for each type of variety.

Criteria: Homogeneity of the variety

Homogeneity rate	Type of variety	Regulation or status
>95% (Off-type rate <5%)	Commercial variety or cultivar that fit DHS criteria	**Directive 2002/53/EC**
> 90% (Off-type rate <10%)	Conservation variety	**Directive 2008/62/CE**
<90 %	Most of the non commercial varieties	
	- cultivated landraces, heirloom, peasant varieties …	**???**
	- non cultivated	**Genetic resources, TIRPAA**

The concept of "off-type" is only relevant for variety where a main type can be described. It is not the case in all the landraces; they are often population varieties in which several phenotypes may be described.

Criteria: Stability of the variety

Stability trait	Type of variety	Regulation or status
Stable	Commercial variety or cultivar that fit DHS criteria Conservation variety	**Directive 2002/53/EC** **Directive 2008/62/CE**
Nearly stable	*Ex-situ* conservation of GR	**Genetic resources, TIRPAA**
Stability of specific traits	- cultivated landraces, local varieties, peasant varieties…	**???**
Unstable	*In-situ* conservation, on farm conservation	**Genetic resources, TIRPAA**

In the case of both concepts “local adaptation” and “genetic erosion”, it is more difficult to determine thresholds in a continuum of variation. They have a dynamic nature.

- The local adaptation of landraces is the result of practices which manage two global characters of the crop: its adaptability and its performance. The adaptability can be defined as the ability to adapt to a variable environment. A landrace appears adapted when it shows good performance in a given area. Nevertheless, traditional practices of the farmers used to introduce continuously heterogeneity in their populations to allow the adaptability to annual variations and to avoid a degenerative evolution. And they reinforce the adaptability by exchange of varieties and seed production in other areas. Thus, the decreasing of genetic variability of a species by genetic erosion may prevent the landraces from maintaining of their adaptability potential.
- Recent knowledge has enriched the concept of species adaptation. For a long time, modern plant breeding methods justified part of their efficiency by the rapidity of the selection response, compared to the slow improvement of the landraces through the agricultural history. The observation of the rapid evolution and diversification of the populations under dynamic management of the genetic resources, adding to the recent discoveries in matter of epigenetic inheritance invite to a new analyse of the farmers’ practices. The hypothesis of a slow evolution of the genetic features is no more relevant. The recent experiments of participatory plant breeding for organic agriculture in Europe have shown the rapid adaptation of plant populations to new agricultural conditions.

4.2 – Local adaptation and region of origin

The text of the regulation concerning the “conservation variety” has extended the notion of local adaptation to the one of “region of origin”.
Are these two notions different?
On one hand, the term “local adaptation” has more agronomical and ecological connotation associated with a dynamic meaning. On the other hand, the notion of “region of origin” gives predominance to the historical and cultural aspects. It also presupposes an ancient adaptation of a variety in one given area. Thus, the policy maker tries to give the limit of time. Nevertheless, all the cultivated species have travelled in the history and were continuously adapted to new environments and practices. In the text of the “conservation variety” law, it is not considered that some regions may possibly become a new “region of origin” in case landraces from other areas are introduced by farmers or other stakeholders. Linking a variety to an area is equivalent to considering the variety as a heritage of the past and not as a continuous process.

4.3 – Genetic erosion and conservation variety

It is acknowledged that the cultivated species have supported a severe reduction of genetic diversity. The “conservation variety” regulation aims to protect landraces threatened by genetic erosion.
We have seen that all the mechanisms of adaptation of the landraces and the maintaining by traditional practices consisted in the management of the diversity, at the individual level as well as the local level. As long as they keep their cultural dimension the quality traits are carefully conserved meanwhile the other characters may evolve to ensure the agronomical adaptation.

What is the place of conservation varieties?
With the qualification “conservation”, these varieties appear to be conceived only to keep the vegetal patrimony of their cultural value, for their traits carefully selected by the rural communities. Nevertheless, knowing the functioning of the adaptation of the populations, their adaptability might be reduced whether we try to apply the DUS criteria on this type of population. Consequently, the landraces candidate to enter in the framework of the Directive 2008/62/CE will have a future of conservation variety and no more as a landrace defined as a “variable population”.

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