FarmSeedOpportunities

Opportunities for farm seed conservation, breeding and production

Project number: 044345

Specific Targeted Research project
Sixth Framework Programme
Thematic Priority 8.1

Specific Support to Policies

Final Publishable Activity Report

Period covered: From January 1st, 2007 to March 31, 2010

Date of preparation: May 2010

Revision: 1

Start date of the project: January 1st, 2007 **Duration:** 39 months

Project coordinator name: Véronique Chable

Organisation: Institut National de la Recherche Agronomique (INRA)

Project execution

Summary description of project objectives

The specific rules for marketing of seeds (set in Directive 98/95/EC) combined with the small market niches for landraces varieties have threatened the conservation of local varieties and the agro-biodiversity. By preparing the EU Directive facilitating the certification and marketing of seed in the interest of conserving plant genetic resources, Farms Seed Opportunities aims to contribute to the enlargement of the market of local varieties, by setting up a science and marketing based framework involving all relevant actors.

To achieve this objective, Farm Seeds Opportunities will:

i) Characterise requirements of the different stakeholders with regards to the diversity of varieties derived from the on farm conservation / management / breeding and of regional agricultural systems in Europe;

ii) Identify bottlenecks and challenges for participatory on-farm breeding and seed production;

iii) Develop methodologies, combining scientific approaches and farmers know-how, suited to targeted improvements of conservation, breeding, seed production and marketing;

iv) Provide practical recommendations for the decision-making processes relating to the market release of seeds of landraces, conservation and amateur varieties;

v) Provide a practical framework for the protection and promotion of landraces, conservation varieties and amateur varieties, especially issued from the participatory plant breeding and small scale breeders;

vi) Provide the society at large with adequate information about scientific results and on-going research in order to answer to its legitimate demand for locally produced food and the preservation of endangered agro-biodiversity and to stimulate its involvement in decision-making

vii) Provide several regulations scenarios to cover most of the described situations in Europe according to the market, the farmers and the breeders needs and rights taking in account the experimental data about the status of the varieties and the seed qualities. These scenarios, from the adaptation of the current DUS regulation to the proposition of new legislations, will necessarily reflect the diversity of the varieties, their use and breeding methods.

Contractors involved

Partner 1- INRA - Institut National de la Recherche Agronomique (France)
Partner 2 - AIAB - Associazione Italiana per l'Agricoltura Biologica (Italy)
Partner 3 - LBI - Louis Bolk Instituut (Netherlands)
Partner 4 – RAS - Red Andaluza de Semillas (Spain)
Partner 5 – RSP- Réseau Semences Paysannes (France)
Partner 6 – PRI - Plant Research International (Netherlands)
Partner 7 – IIED - International Institute for Environment and Development (United Kingdom)
Partner 8 – FiBL- Research Institute of Organic Agriculture (Switzerland)
Partner 9 – IT- Inra Transfert (France)
Partner 10 – WU - Wageningen Universiteit (Netherlands)
Partner 11 – IGSA - Istituto di Genetica e Sperimentazione Agraria Nazareno Strampelli (Italy)
Partner 12 – DLO- Stichting Dienst Landbouwkundig Onderzoek (Netherlands)

Coordinator contact details

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Project logo

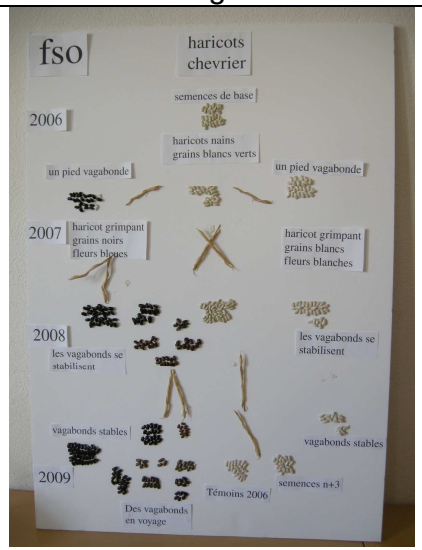
Reference to the project public website

The public website is available at: http://www.farmseed.net

Diagrams or Photos illustrating the work of the project

IFOAM Congress – Modena 2009

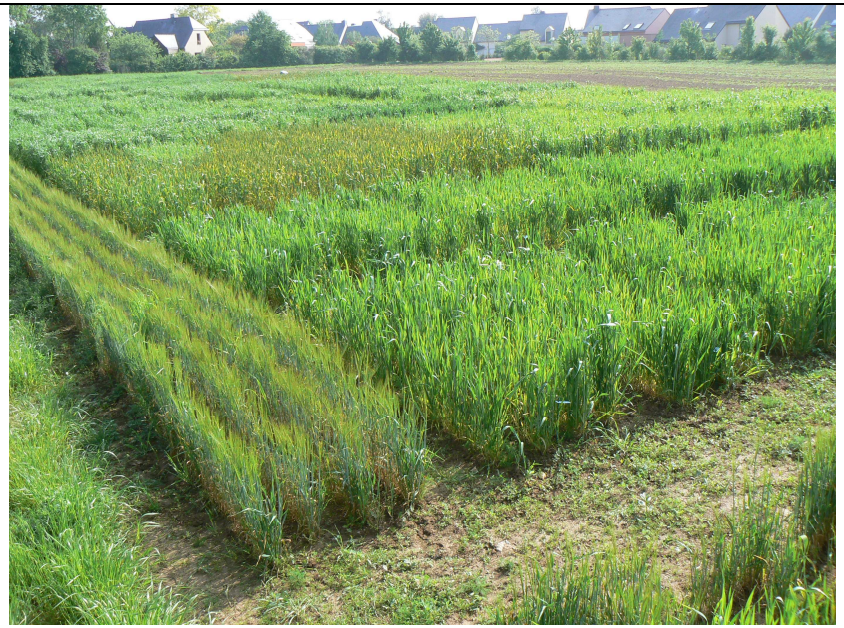
FSO KOM – Rennes 2007

Sevilla Meeting - 2008	Sevilla Meeting - 2008
 Presentation of the Report on stakeholders' view on EU seed laws – Brussels 2009	 International Conference – Marseille 2009
 International Conference, Farmers' forum – Marseille	 International Conference, Farmers' forum – Marseille 2009

2009	
 International Conference, Farmers' forum – Marseille 2009	 International Conference, Presentation of the Secretariat of the ITPGRFA – Marseille 2009
	

Spinach trial in the Netherlands - 2007	FSO beans overview
 Field maize measurement (Italy) - 2007	 Demonstrating FSO wheat trial to consumers_(The Netherlands) - 2007_

Field visit (France) - July 2009



Global wheat trial in Rennes - 2009

Harvested collection in France - 2007

Community seed bank (Spain)

Meeting with farmers in Abruzzo (Italy) - 2007

Community seed bank (France)

Summary for the entire period of the work performed and main achievements

Introduction

Before modern plant breeding was established, landraces were developed by farmers with specific characteristics that made them distinguishable from each other. Especially diverse local growing environments, agronomic conditions, and cultures made this variation in landraces possible. Since 1900, as modern plant breeding practices were increasingly adopted, these variable landraces were gradually replaced by more uniform cultivars that often had higher yields. The industrialisation of agriculture has changed our vision of fields and plants, both for scientists and farmers. Current seed policies have been conceived in order to accompany this agricultural evolution and aimed at increasing the use of modern varieties and at the same time protecting farmers as seed consumers. Seed regulations encouraged a dominant concept of cultivated varieties which includes the criteria of Distinction, Uniformity, Stability (DUS) and Value for Cultivation and Use (VCU) for arable crops.
Nevertheless, a different agriculture strongly connected to "terroir" (a French word that refers simultaneously to the soil, climate and cultural values of an area, similar to the English notion of "place") has been preserved and is now re-emerging in Europe. This alternative agriculture is based on different varieties than conventional agriculture, ones with strong local adaptation. Locally adapted varieties, old landraces and mixed populations play an important role in organic agriculture. In addition, quality aspects linked to specific regional or craft products are generally important in alternative agricultural systems, and are often responsible for the preservation of local varieties.
In 1998, for the first time, the European Directive 98/95/CE mentions the essentialness of ensuring the conservation of genetic resources and the necessity of introducing a new catalogue with different rules which would include varieties called "conservation varieties" which are threatened with genetic erosion.

To our opinion, the large diversity of experiences and initiatives is not fully integrated in European laws and policies.
Farm Seed Opportunities (FSO), a specific targeted research project in the FP6 European Research Framework (2007-2009), was conceived to support the implementation of seed regulations on conservation varieties (directive 98/95/EC and new directives 2008/62/EC and 2009/145/CE) and to propose complementary seed regulation scenarios taking into account the diversity of the European seed systems. The countries involved in the project (NL, I, F, S, CH, UK) represent the diversity of the North and South Europe situations. Eastern and Central Europe will be represented by Hungary and Romania and were involved for workshops. The partners represented several kinds of actors who are already involved in genetic resources, on-farm breeding and/or participatory plant breeding with farmer networks using all kinds of landraces and local varieties. The market and/or the specific agricultural valorisation of these varieties are also represented by several partners, either by organic research or farmer organisations (NL, F, CH, I), either by networks for peasant seeds (F, S). The international expertise is brought by IIED (UK) who is involved in participatory action research in developing countries.

In the framework of Farm Seed Opportunities project, the research activities and the dissemination of the results were organised in 4 workpackages:
- WP1 contributed on the one hand to a better knowledge of the seed context in its diversity in Europe and on the other hand, performed a thorough analysis of the current regulation texts. The terms landrace, local variety, traditional variety, conservation variety, peasant/farmers' variety and population variety are often used interchangeably, and one of the goals of FSO is to bring greater clarity to the definition of these categories with the goal of developing appropriate policies. We have also illustrated the specified notions, written in the EU regulation 98/95, like the local adaptation and the threat of genetic erosion. The project has characterized stakeholder expectations by the means of a survey, in their diversity in the consortium's countries. WP1 analysed the matches and mismatches between the directive on conservation varieties with current practice in the conservation and use of varieties and landraces that are not included in national (and EU) varieties lists. This study therefore aimed at analysing whether the Directive may be considered a contribution to the conservation and continued

use on-farm of a wider array of field crop varieties, or that the regulations may curtail current practise. The last aspect of the WP was the analysis of diversity issues in varieties that may not fall within the definition of 'conservation variety' developed through non-conventional breeding methods (e.g. multilines, populations/hybrids of non-inbred parents), and the concept of "farmers' new varieties" derived from farmer breeding or participatory breeding initiatives.

- WP2 has collected knowledge about on farm breeding methodologies for the conservation and development of landraces, amateur and conservation varieties. The starting point for the development of these methodologies was to gather the already existing experiences of farmers, small-scale seed producers and researchers. This approach was completed by the production of experimental data which aims to be used as a reference to recommend modification of the current regulations and/or to suggest a new place for these types of varieties alongside the current regulations. The participatory on-farm research has been recently developed in Europe. The partners (researchers and farmer organisations) are pioneer for participatory organic plant breeding in their country. Their experiences on on-farm maintenance and breeding will be shared and widened in a common experimentation of landraces/local varieties. Their network was the basis of a trials organised over three countries (NL, F and I) on 25 farms on 4 species (wheat, maize, bean and spinach). Then, this WP produced an overview of innovative participatory methodologies and approaches that can be used in on farm conservation and management of agricultural biodiversity in Europe.

- WP3 focused on seed quality and recommendations for production and market. In parallel to the field trials on wheat, bean, spinach and maize, FSO carried out the analysis of seed and grain produced by the farmer involved, with the aims of (i) identifying technological and economic key constraints in seed production and (ii) developing methodologies for seed production. The FSO main conclusions are here presented and some practical guidelines and recommended procedures will be given for the production of quality seed.

- WP4 has enlarged the context, integrated the outputs from previous WPs and disseminated all our results.
About the context, one task was to share partners' view and outcomes with other experts and stakeholders from countries not included in the project and particularly southern countries. This exchange took place during the Marseille International Conference in October 2009. Another task analysed the possible linkages between plant genetic resources (PGR) conservation (one of the aim of the new rules on conservation varieties) and marketing tools for the so-called biodiversity produce. Case studies illustrated the link between conservation, use and valorisation with a particular attention to the linkages between varieties and culture and to the creation of innovative market more suitable to this specific produce.
The integration of FSO outputs leads to the conclusion that space is missing in Europe for non-uniform and non-stable varieties, mainly population varieties, or farmers' varieties, which could be very relevant for the maintenance of food tradition and organic and low-input farming systems. We brought the definitions of the varieties for legislative purposes, the legislative scenarios which have taken into account all kind of varieties described in Europe. These preliminary propositions were submitted to experts for discussion.
FSO presented during its three period several communications in order to stimulate the recognition of an "informal seed systems" in Europe and to inform abouhe possible consequences of different laws and regulations over the land management, agricultural sector, ag-research, production and consumption patterns at global and local scale.
All the deliverables will be published on the project website, and spread through conferences, publications and other media, such as websites, a booklet and a CD-Rom with all the FSO outcomes.

WP1 Determination of stakeholder expectations

WP1 contained three tasks (task1.1, task1.2, task1.3) and has produced two interim reports (D1.1 and D1.4a) and three publishable reports: D1.2 on the different definitions or interpretations of the concept of land races, conservation varieties and amateur varieties; D1.3 on the various stakeholder expectations; and D1.4b on match and mismatch of expectations to the (draft) regulation text of Directive on conservation varieties. All the countries of the consortium were involved; Hungary and Romania were added to this analysis and have given their valuable contribution in the FSO-meeting in November 2008.

In task 1.1, the different (interpretations of the) definitions of concept of landraces, conservation varieties and amateur varieties among different stakeholders in different countries and/or regions were investigated. We analysed the "variability" of the local definitions to identify conflicting areas between current practices and current (draft) regulations 98/95. Special emphasis was given to the notion of the concept of local adaptation and 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. Input was given by the partner countries to identify country based definitions by a web forum and results were processed. Additionally a literature review and expert contacts resulted in a draft report D1.1 which was discussed during the FSO meeting November 2008 with invited experts. The report was thereafter further completed into the final report D1.2. The results can be summarised as follows.

The diversity of the approaches encountered in the Member States could be evaluate through the diversity of the translations of the word "landrace" in the national version of the directive. Stakeholders' consultations also revealed that concepts dealing with landraces are frequently mentioned in everyday life in EU countries. Most of them use terms that refer to either the regional or historical patrimony, either ecological or socio-economical values. History of cultivated species shows that local adaptation is relative in time. Going back in the history, one could find out that within a certain region, each historical period has had its own distinct set of varieties, which could be considered as local varieties. This shows that linking a conservation variety to a certain region of origin, such as required in the new directive, is highly questionable or at least that this concept can be useful for some type of conservation varieties – mainly which are called local varieties – but not for all. In general, an evolutionary approach is needed regarding the history of varieties and the agriculture, in order to promote within seed legislations further evolution and creation of diversity. Inherent to adaptive potential is the amount of genetic diversity present within a landrace. Genetic erosion, a decrease of genetic diversity, also diminishes the adaptive potential of a variety. The new directive requires describing varieties on the basis of Distinctiveness, Uniformity and Stability. If the Uniformity requirement is applied too strictly, this will cause a decrease of genetic diversity and hence increasing genetic erosion and decreasing local adaptation potential. This would endanger one of the main aims of the directive, namely preventing genetic erosion. Concerning the definition of genetic erosion of conservation varieties it should be noted that it is very difficult to define the levels in plant genetic resources, because it is not easy to express its state in numerical terms. First and foremost a census or a list of the local varieties still grown by farmers would be needed in order to estimate the risk of inter-varietal erosion. Secondly, the variability of each local variety would have to be known - these are often fairly heterogeneous populations – to estimate the risk of intra-varietal erosion. Obviously, the absence of a preparatory cognitive survey makes it very difficult to indicate the risk of genetic erosion of a specific resource. Furthermore, even assuming being able to quantify the risk of erosion there is still a marked contradiction. When the seed of a conservation variety is sold in conformity with all the rules, can it still be considered at risk of genetic erosion? The answer most in line with the objective of the directive is that once it is marketed the variety becomes no longer at risk although it is still a "conservation variety", even though the directive says the contrary since it has lost its qualifying property of being at risk of genetic erosion.

Within the task 1.2 (leader A. Thommen-FiBL/CH), an expert survey among stakeholders of the marketing chain of conservation products was conducted, to provide an overview of types of stakeholders related to the topic of the project, and to report on stakeholder expectations of bringing biodiversity to the market / niche markets, including added value and volume. The report also aims at providing stakeholder point of views on ethical aspects of breeding methods (e.g. gmo, hybrids versus open pollinated varieties). Partner institutions of five countries (France, Italy, Spain, The Netherlands and Switzerland) made interviews with 33 experts of 27 organisations active in marketing of

conservation plant crops. The 101 questionnaires were returned and analyzed at the Research Institute of Organic Agriculture in Frick, Switzerland. The preliminary results were discussed in the common FSO project meeting in Spain 2008 and the report (D1.3 was finalised in February 2009. The following main conclusions from the experts' interviews can be drawn. The most important findings were that most initiatives working with conservation varieties are rather small and still in a start-up-phase, they work with highly motivated, but scarcely financed staff, and depend partly on funding of private or most often public donors. Marketing of conservation products has great opportunities and product launching is relatively easy and with minor economic risks. However, the profitability of the products is due to small scale economies relatively low. A majority of the marketing project has the focus on covering niche markets and tries to combine product marketing with sensitisation and raising of the awareness of the consumers for the problem of genetic erosion. Most initiatives try to place the products in the premium price segment and combine it with premium cultivation labels, such as organic production. Important factors of the marketing strategies are inner quality, such as taste of the products and a high product image which can be clearly differentiated from mainstream products. The image of the product is dependent of the former popularity of the crop and is linked to the reputation of the trade organisation and the farmers. Main sales argument is the product "story", exterior quality or regionality of the production is estimated to be of minor importance. More activity and more financial commitment of the public sector are urgently needed. Sensitising of the consumers has first priority. Financial subsidies are inevitable especially in the start-up-phase of marketing projects. Seed trade and variety protection laws, with less impact consumer protection legislation are seen as the main obstacles for the development of this niche market. Access to public gene banks should be enhanced and the gene bank conservators should be more active in characterisation and agronomic evaluation of their plant genetic material.

Many initiatives have experienced constraints in meeting policy maker requirements on regulations and legislative affairs. Based on these experiences sometimes collected in national workshops such as in the Netherlands, task 1.3. analysed the matches and mismatches between the directive on conservation varieties with current practice in the conservation and use of varieties and landraces that are not included in national (and EU) varieties lists. The fact that such varieties are (still) in use, means that countries have for a long time either approved or decided not to control the use of such varieties. The Directive aims at contributing to the conservation and use of crop genetic resources; it intends in fact to regulate some gaps in existing seed regulations. This study therefore aimed at analysing whether the Directive may be considered a contribution to the conservation and continued use on-farm of a wider array of field crop varieties, or that the regulations may curtail current practise. Good seed is important for every farmer. Purchased seed has to match the expectations of the buyer even though most quality factors cannot be identified by simply looking at the seed. The varietal identity has to be guaranteed and the varietal uniformity should be within the expectation range. Also the physical purity, viability and health status must be good, the latter being particularly important in ecological farming. Various concerns can be raised to the text of the directive, but most of these may be tackled in the implementing rules that individual countries are about to draft. One key concern deals with the uniformity requirement. We therefore analysed current methods and standards for uniformity and conclude that with regard to the registration of varieties, the same methods may be used for conservation varieties with the exception that methods developed for cross fertilizing crops may need to be applied for the description of self fertilising conservation varieties. This solution has – however obvious it may be – not been included in the regulation. The issue of uniformity standards should not apply since the key element for conservation varieties is identifyability and not uniformity. However, two issues need careful consideration: the inherent lack of stability of landraces may require regular re-testing or a wider interpretation of the description (identity) of the landraces being considered as conservation variety, and the fact that current seed certification standards for uniformity are much stricter than the registration standards. These aspects need to be dealt with in the implementing rules at the national level. One aspect is dealt with in a separate chapter: an analysis of diversity issues in varieties that may not fall within the definition of 'conservation variety'. We introduce "new population varieties", as varieties developed through non-conventional breeding methods (e.g. multilines, hybrids of non-inbred parents), and the concept of "farmers' new varieties" derived from farmer breeding or participatory breeding initiatives. Registration authorities need to find ways to allow such varieties and at the same time avoid creating. The report finally deals with a brief analysis of the positions of countries (country representatives in the negotiations in Brussels) that led to the formulation of the directive. A key conclusion of this rather limited exercise is that the countries with a strong (conventional) seed industry have had a predominant position in the debate and not those that harbour the largest number (or acreage) of conservation varieties.

We presented the results and remaining questions to the FSO meeting with experts in Brussels (Sept 09), and to a wider audience of stakeholders in Marseille (Oct 2009), and in the final project meeting in Frick (Dec 09) and finally asked three external experts to give input from their experiences on the match and mismatches of the regulation text based on cases in several countries. The final publishable report was completed at the end of the project.

WP2 Improving maintenance and breeding

WP2 general organisation: WP2 was organised in 3 Tasks. Task 2.1's objective was to identify breeding initiatives in Europe which involve seeds of landraces, conservation varieties and amateur varieties and to elaborate case studies of a selection of these initiatives. The objectives of Task 2.2 were to analyse the genetic and evolutionary mechanisms in on farm breeding and to identify bottlenecks or key points. Task 2.3 aimed at developing methodologies and know-how adapted to answer to the different conservation and breeding objectives.
WP2 produced one interim report D2.1 and 3 publishable reports D2.2, D2.3 and D2.4. The deliverables D2.1 and D2.2 were merged as a single report including all aspects of the deliverables: the identification of the existing breeding initiatives of seeds of landraces, conservation varieties and special "amateur" varieties and the description of these initiatives in five European countries. Because of their tight connection, it appeared more relevant to develop the description of existing breeding initiatives as a continuation of the identifcation of these initiatives.
The deliverable D2.3 analysed the bottlenecks and challenges identified for the on farm maintenance and breeding in European agricultural conditions based on the experimentrealised in T2.2 and the deliverable D2.4 proposed innovative approaches in participatory research, on-farm conservation and the management of agricultural biodiversity in Europe. It has been slightly re-oriented compared to the initial title ("Innovative methodologies relevant for the on farm maintenance and breeding of landraces, amateur varieties and conservation varieties"), because the aspects of particpatory research has emerged as a key point for the on farm maintenance and breeding of these varieties.

Task 2.1 realised a first inventory which resulted in some 40 initiatives in 15 countries, which after completion by FSO partners, resulted in additional initiatives. The initiatives were divided in 5 different types of initiatives: 1) Farmer Breeders, 2) biodynamic breeders of Landraces, 3) Seed producers, 4) Seed savers, 5) *In situ* conservation initiatives.
The first three groups are involved in breeding, while the last two groups try to conserve landraces. Therefore for the case studies five examples were chosen that covered the first three categories and different countries: 1) Touselle (France) – Farmer breeding; 2) Vegetable breeding by farmers in collaboration with scientists by PAIS, Brittany (France); 3) Solina (Italy) – Farmer breeding; 4) Allkorn (Sweden) – a bio-dynamic breeder); 5. Kultursaat (Germany) – a seed company associated with farmer breeders.
The case studies gave insight in the different motivations of the initiatives to get involved in breeding, breeding methodologies applied and achievements and problems encountered. This information was used as input in Task 2.2. (identification of bottle necks and challenges for maintenance and breeding) and Task 2.3 (development of innovative methodologies for maintenance and breeding). The information has been also useful for those existing and starting breeding initiatives that want to improve their work.

In **Task 2.2**, on-farm field experiments were conducted with "non-conventional varieties" (landraces, old varieties and new farmers varieties) during the 3 consecutive years of the project (2007-2009) with the objectives of assessing the evolution / adaptation over time and space of these varieties when they were moved from one environment to another. These experiments were carried out in The Netherlands, in Italy and in France. A large experiment of 25 trials on 4 species (wheat, maize, bean and spinach) has started in 2007 (or autumn 2006 for bread wheat) and has been conducted for three years in the three countries as followed:

- eight trials for wheat (four in France, two in Italy, two in The Netherlands),
- five trials for spinach (four in France, one in The Netherlands),
- 10 trials for bean (six in France, two in Italy, two in the Netherlands),
- three for maize (two in France, one in Italy).

In 2009, an additional common trial was conducted in one site (Le Rheu experimental station) under organic farming system. This allowed to compared all versions of the varieties that have been grown on farm for two generations with the initial samples (or other reference samples).

Each species underlined a specific aspect of plant breeding / on farm conservation. For maize and spinach, mass selection was applied by the farmers which allowed to characterise the effect of the farmers' selection and practices. For beans, various breeding strategies have been developped by the farmers illustrating the diversity in the way farmers interact with the varieties. For wheat, very little or no selection was applied by the farmers which led to mostly assess the effect of natural selection/adaptation within each environment.

First year results: In 2007, quantitative measures were recorded mainly on the wheat experiment where 10 varieties including 8 farmers varieties from French, Deutch and Italian farmers and 2 modern DUS varieties have been grown on farm. Qualitative observations, environmental conditions and farmers practices were recorded for the other species. Although modern varieties must pass strict criteria for homogeneity before being released, it appeared that under on-farm organic and low-input conditions, characterized by heterogeneous environments, modern wheat varieties may be just as variable phenotypically as some landraces for certain seed production traits while landraces often had unexpectedly low within-variety variability. In bean, variation for flowers, pods, seeds, was found within the landraces which did not correspond to « original » description but was interesting for the farmers. For certain species such as bean, farmers found interesting to apply mass selection or selection of phenotypic "variants" within traditional landraces. Based on the first year results, a scientific article has been written which under review, and a communication was made at the IFOAM 2009 conference.

Global results: The FSO original and extensive experiment based on four crop and vegetable species allowed to obtain an accurate characterization of varieties evolution over time in response to drastic environmental changes and contrasted farmers practices on-farm. Overall, after only 2-3 years of on-farm growing, evolution over time appeared significant for many traits assessed both on-farm and in station. Significance and range of evolution depended on the varieties, the farmers practices and farm environmental conditions, and the trait. Although lower, this trend was also found for modern DUS varieties. Yet, all varieties stayed distinct based on multivariate assessment.

Bottlenecks and challenges in relation to seed regulation were identified and and propositions for scenarios were made:

* *Distinctiveness*: Distinction among varieties using phenotypic observations (in the field or or on harvested grains/material) was always possible. This was true even in the presence of strong GxE interactions which modified phenotypes from one farm to another and even when varieties appeared heterogeneous. The landraces were more diversified than the varieties registered in the official catalog.

* *Homogeneity* : The UPOV protocols define homogeneity as a percentage of "off-type" plants; this seems difficult to apply in the case of landraces, population or new farmers' varieties. In the FSO experiment, measures on individual plants for each variety and in each trial were used to assess the level of homogeneity within each variety. For a few criteria (e.g. plant height for wheat), the varieties registered (official catalog) were much more homogeneous than the landraces. However, for the majority of phenotypic traits measured, under on-farm conditions the level of intra-varietal heterogeneity was comparable among landraces and modern varieties. Thus, based on the FSO experimental results, the standard of homogeneity as understood in UPOV and the official catalog is not relevant and does not make sense when varieties are observed and described on-farm under organic or low-input conditions.

* *Stability in space*: A single initial variety, cultivated in contrasting environments (the Netherlands – France - Italy) could (i) perform differently depending on the environment (GxE interactions), (ii) evolve in a different manner in each environment depending on environmental and cultural conditions in the course of only two years of differentiation. Landraces were neither more or less "stable" than modern varieties over the 6 farms in terms of GxE crossover interactions.

* *Stability in time*: In the common experiment at le Rheu 2009 as well as in the on-farm experiments, we found that for most of the characteristics measured, phenotypic expression had changed. Thus, two-three years of cultivation in contrasting conditions appeared to induce variations in phenotypic expression, including for the catalog varieties. Despite these changes in quantitative traits, however, each variety remained distinct and recognizable. Some farmers explained that it takes 4-5 years for a

landrace to adapt to the conditions on their farm; after this period, the population's performance stabilizes for agronomic traits, even while it stays heterogeneous at the individual plant level. The length of this project did not allow to evaluate this facet of phenotypic stability in farmers' fields, but this "stability" (buffering capacity) due to diversity (≠ UPOV definition of stability) remains a major reason for using landraces.
Utilization of the UPOV criteria of homogeneity and stability therefore appears to us to be inappropriate for describing conservation varieties or any other variety cultivated *in situ*; only the distinctiveness criteria appears to be useful and is not called into question by either the non-homogeneity or the non-stability of these varieties.
* *Limited Geographical Zone*: Some landraces gave very good results, sometimes even superior results, for certain productivity traits outside their zone of "origin" or "natural adaptation". Therefore, limiting cultivation of these varieties to a narrowly defined geographic zone would limit farmers' choice of and access to potentially interesting landraces and historic varieties. In addition, the reduction of permitted cultivation to a legally defined geographic zone for conservation varieties would increase genetic erosion in these varieties both by limiting population numbers and sizes and by limiting the range of environmental conditions to which the variety is exposed (thus impeding their evolutionary potential).
* *Genetic Erosion* : The results of a study conducted on the dynamic management of wheat populations (INRA) showed that a network of on-farm sites can maintain the overall genetic diversity as long as the sites and cultivation practices are diverse (metapopulation principles). Another study on the Rouge de Bordeaux variety conserved in the French farmer network (RSP) showed the complementary nature of *in situ* dynamic management and conservation in the national genebank. While samples conserved in the genebank only captured and maintained a small part (often a single genotype) of the diversity initially present in a landrace, the evolution and adaptation that can develop after many cycles of cultivation in situ in contrasting conditions permits the diversification and the maintenance of the evolutionary potential of a variety.

The **Task 2.3** provided an overview of innovative participatory methodologies and approaches that can be used in on farm conservation and management of agricultural biodiversity in Europe. A final report summarising lessons learnt from FSO (and other) experiences on participatory on farm management of agricultural biodiversity was prepared. Particular attention has been paid to how—and under what conditions—participatory plant breeding and seed production can be more widely encouraged in Europe. The analysis was based on observations from the FSO project as well as other case studies and the wider literature.
In recent years there has been a rapid expansion of new participatory methods and approaches in the context of Participatory Plant Breeding / Participatory Varietal Selection (PPB / PVS) and, more generally, in agricultural research and development. These have drawn on many long-established traditions that have put participation, action research and adult education at the forefront of attempts to emancipate disempowered people. Effective use of these participatory methodologies often depends on the existence of platforms that bring relevant actors together to mobilise capacity for social learning, negotiation and collective action for research into the management of agricultural biodiversity. Platforms range from farmer networks to farmer field schools and/or project partnership as in the case of FSO. For both scientific and technological research, as well as the evaluations of PPB/PVS research products and impacts, a suite of methods for participatory inquiry can be combined in different sequences (as proposed in D2.4). Other kinds of participatory methods may be more appropriate for involving farmers and citizens in the upstream definition of research priorities and the framing of broad policies for agricultural research and development. These methods for Deliberative and Inclusive Processes (DIPs) include citizens' juries, scenario workshops, public hearings and visioning exercises. Recommendations were made for the EU on how to improve design and management of projects on participatory plant breeding, participatory varietal management, and other innovative methodologies in Europe.

WP3 Improving seed production and marketing

WP3 general organisation
WP 3 had two tasks: task 3.1 Development of seed production methodologies to produce healthy quality seed and t ask 3.2. Development of post-harvest technologies, inspection and marketing techniques to be used for seeds of land races, conservation varieties and amateur varieties. The aim was to identify technological and economic key constraints in seed production and marketing in the existing European initiatives on production and marketing of land races, conservation varieties and amateur varieties; and then propose the development of methodologies for seed production and marketing in a participatory innovation development approach, involving all relevant actors. Both scientific and policy aspects are closely linked in this workpackage and will focus on the seed qualities characteristics, in their specific market, and for the main criteria needed for seeds regulation. The main methodology was an inventory of farmer' practices in seed production and investigated the quality of the seed. The Deliverables are: D3.1. Seed quality recommendations as a document describing the most relevant quality characteristics, their recommended minimum requirements, and recommendations to achieve high quality production; and D3.2. Seed marketing recommendations, as a document describing the additional non-traditional quality characteristics, their minimum requirements, and how to control them; instructions for seed handling, sampling and packaging.

The activities can be summarised as follows:

Purity
The analytical purity of a seed lot expresses the amount of pure seeds as well as its admixtures such as weed seeds, seeds of other crops and inert material (sand, chaff etc.) (ISTA, 2010a).

The purity results for wheat are satisfactory, with most lots meeting the EU norm of 98%. For maize and beans the purity is almost always near to 100%. For spinach we received unprocessed seed.
It was observed however that many farmers lack the possibility to clean their seed properly. Seed cleaning equipment and drying facilities are expensive, so farmers sometimes do this collectively. In case of farmers producing flour or bread from their harvested grain, they are aware that it is of great importance to clean the grain properly in order to protect consumers from poisonous weed seeds or contaminants such as ergot.

Germination
The germination of a seed lot is expressed as the percentage normal seedlings. In maize, but also in wheat and spinach, the germination results were mostly above the minimum norm. There is a difference between seeds from the trials and seed produced by farmers for their own use. This is due to the setup of the experiments, in which farmers participating in the trials harvested the plants as it was without further selection, allowing genetic drift to occur. This was how some farmers perceived the nature of the experiments. Others selected within the plant population. As a result the quality of the seed produced and replanted in the FSO experiments was quite variable.
The seeds of maize and spinach also met the minimum norm in most cases. Unlike in beans, which is a notoriously difficult species to produce.

Here we have to make some observations. Producing well-germinating bean seeds is more difficult than for most other vegetable species. This is due to the nature of the seed, having high oil and protein content, their size, their vulnerability, their natural enemies, etc. So therefore the EU norm has been put at 75% in order not to have shortages of seed. This is also the reason why many (amateur) farmers normally plant 3 or 4 seeds in one hole, to compensate for non-germinating seeds.
The present results have been obtained from the trials and it must be mentioned that many farmers are actually specialised in wheat growing, not in bean seed production. Moreover, the initial seeds given to these farmers apparently contained diseases already, making it almost impossible to produce good seeds. Surprisingly, and maybe due to selection by the farmers, the crops in years 2 and 3 looked much healthier.

Seed health

The object of the seed health test is to determine the health status of a seed lot (ISTA 2010b). This is done by estimating the presence of pathogens present on or in the seeds.
These pathogens may or may not give rise to disease development in the field, very much depending on the genetic background of the seed (tolerance or resistance), the environmental conditions during crop establishment and growth, and the crop management used.
Disease management is an important aspect of crop growing, also for low-input and organic agriculture. In order to have the best possible performance it is important to start with seed that is free of pathogens as much as possible

Wheat
The majority of farmers produced lots with a low infection level.
The test results (with and without hypochlorite) indicate that it is necessary to take extra measures, such as specific seed treatments like the use of natural plant products or hot water treatment to remove or neutralise the inoculum.
The presence of *Fusarium*, but especially of *Nigrospora*, is problematic because of the production of mycotoxins. A hypochlorite treatment on grain for food purposes is undesirable however. It is important that farmers are aware of this problem. Indeed, the farmers who are using the grain for producing bread which they sell directly to consumers take particular care when handling the grain for that purpose.

Beans
The present results (of both germination and seed health) have been obtained from the trials and it must be acknowledged that many farmers are actually specialised in wheat growing, not in bean seed production. Moreover, the initial seed given to these farmers apparently contained diseases already, making it almost impossible to produce good seeds. Surprisingly, and maybe due to selection by the farmers, the crops in years 2 and 3 looked much healthier. This is in part corroborated by the virus and bacteria analyses of later years. Finally, the analyses were based on too small amounts of seeds. Very often only 50 seeds or even less were available for germination tests, while 400 seeds are considered the minimum. The same applies to the virus and bacteria tests.
In the last year we tested four samples from a professional organic seed producer, of which three were free from BCMNV and BCMV, and one contained BCMV, despite the fact that it was produced in a controlled multiplication in another project aimed at improving quality of farm seed.
This demonstrates the difficulties encountered in bean production. Farmers are aware of this, and some specialise in bean production, while others stay away from it. Beans are recognised as a species that requires special skills and attention.

Conclusion
Farmers are able to produce seeds up to EU standards. Seed production needs special skills, and farmers are using their networks to improve these. Projects like FSO are needed to generate exact figures and to provide guidelines for future activities. The presence of diseases on grains needs special attention.
Part of the analysed seed samples came from the WP2 trials which aim to assess the adaptation process of varieties when they are moved from one environment to another. These were not representative of the usual farmers' procedure for seed management. Yet, this protocol has allowed to establish the impact of this environmental change on crop performance as well as on seed quality.

References
ISTA 2010a. International Rules for Seed Testing. International Seed Testing Association. Bassersdorf, Switzerland.
ISTA 2010b. Annexe to Chapter 7: Seed Health Testing Methods. ISTA, Bassersdorf, Switzerland.

WP4 Integration, decision making support and outreach

WP4 contained three tasks (task1.1, task1.2, task1.3); and has produced three publishable reports: D4.4 on the Analysis of relevant cases studies on the Role of Innovative Market Promoting Sustainable Use of Agrobiodiversity; D4.5 on the feedbacks received by experts; D4.6 on final recommendations. WP4 also has published the project website (D4.1), the project leaflet (D4.2) and the final CDROM with all the FSo deliverables (D4.7). All the countries of the consortium were involved. Experts from Hungary; Nepal; Norway; Italy; Brazil; Peru; Spain; Switzerland and Canada contributed to the task 4.1, 4.2 and 4.3 sharing their experiences, presenting their siatuation regarding seed laws and commeting D4.6.

In task 4.1 (leader R. Bocci, AIAB) the main objective was to share partners' view and outcomes with other experts and stakeholders from countries not included in the project and particularly southern countries. This exchange took place during the Marseille International Conference in October 2009. The methodology adopted was to have an in depth discussion during the International Conference, specifically about the impact of different seed laws on on-farm conservation and participatory plant breeding. The results of this task has been integrated in the deliverable 4.6 "Set of recommendations about on farm conservation strategies". The need of having an exchange of experiences between different countries was confirmed during the International conference. In fact, only through this sharing of knowledge and experiences was possible to develop innovative ways for on farm conservation. This aspect could be useful also for future projects dealing with plant genetic resources conservation and breeding.

Task 4.2 (leader R. Bocci, AIAB) analysed the possible linkages between plant genetic resources (PGR) conservation (one of the aim of the new rules on conservation varieties) and marketing tools for the so-called biodiversity produce. Indeed one of the activities pointed out by the Global Plan of Action for the sustainable use of PGR is "Developing new markets for local varieties and diversity rich products", as underlined in section 14. The development of instruments geared toward a sustainable use of the PGRFA includes appropriate relationships with the market and strategies for the valorisation of the produce.
This task produced the Report on Analysis of relevant cases studies on the Role of Innovative Market Promoting Sustainable Use of Agrobiodiversity, with a collection of case studies from Spain, Italy, France and The Netherlands aiming at showing the link between conservation, use and valorization. A particular attention was paid to the impact of innovative market on local varieties and cultural diversity. Particular emphasis was also paid to the linkages between Geographical Indications and plant genetic resources conservation, finding a bridge between different tools and policies developed by the European union. The methodology and strategy used were the following:
1. An analysis of the market of geographical indications in the country (how many and how many related to local varieties). ;
2. An in depth description of some of them that are more interesting for our project (it means: the seeds related to the GI are listed in some catalogue or not, how seeds are reproduced each year, is there a sort of informal seed system in place?). In this case it could be interesting asking to the people responsible of the GI if they consider useful the new directive on conservation varieties and why.
3. a general presentation of other possible market or label for agricultural produce linked to local varieties or agrobiodiversity (for example in Italy we have the private slow food label).

The survey pointed out that many GIs included in the EU catalogues are based on local varieties that are not listed in the official catalogue of varieties. It means that at least from a legal point view the seed of these varieties should not be commercialised or traded. In the other side, we found that the GIs legislation could fit very well with the new directive on conservation varieties, at least for some of our case studies. The former protecting and valorising the market of the produce, the latter the market of the seeds. It was a qualitative analysis, but it could be useful for suggesting future connections between seed laws and niche market of the biodiversity produce. In fact, in our literature survey we

found very few studies on the linkages between the conservation of PGR and Geographical indications.

The aim of task 4.3 (leader V. Chable, INRA) was the analisys of the varieties cultivated in Europe and the proposition of legislative scenarios, which should take into account all kind of these varieties. FSO found that space is missing in Europe for non-uniform and non-stable varieties, mainly population varieties, or farmers' varieties, which could be very relevant for the maintenance of food tradition and organic and low-input farming systems. Task 4.3 has collected and integrated the output from previous WPs and deliverables. The preliminary outcomes were submitted to experts for a thorough email discussion.

FSO Reports painted a broad picture of the variety and seed situations in Europe. The first and foremost result is that Europe is still full of diversity, at cultural, environmental, climatic and farming level. Even if the formal system tends to impose its norms and modernization through regulations, it fails to answer to the diversity of the European farming systems. For that reason, many farmers – mainly in alternative farming systems – don't find the seed they want through the formal seed system.

Traditional (or "informal") seed systems still remain and innovation appears within these systems, based usually on traditional or local varieties. Even if agricultural modernization has changed the landscape of Europe in the last 40 years, no-marketable seeds have still their place in agriculture also from the economic point of view (seed Deliverable D.4.4 "National survey on the role of innovative markets"). FSO found that alongside the dominant conventional agricultural practices, many kind of varieties are still cultivated in farm fields, which don't fit exactly to the actual seed legislation. At this regard, it is to be stressed that conservation varieties will be limited to a specific kind of variety for which a link with a certain territory will be historically demonstrable. This, therefore, is not a category for lumping together all the varieties, whose seeds at the moment cannot be marketed, and for which it will be necessary to explore different legislative openings.

In particular we refer to the following categories:

a. The varieties produced by participatory plant breeding (PPB) not in conformity with DUS requirements;

b. The old varieties no longer registered in the Catalogue (there are factors that can make registering these varieties problematical: excessive registration costs, difficulty in proving the VCU, only limited marginal areas interested in growing them) and which do not have a precise geographical area of origin;

c. Local varieties used as genetic resources in reintroduction programmes, to cultivation in different areas from their area of origin;

d. Variety – Populations that have no historical link with a given territory or that have been bred by innovative methods based on the natural mating system of the species and which capture the advantages of the diversity, a and which cannot be registered in the official catalogue having no correspondence with the DUS criteria.

Finding a right balance between formal and informal seed systems within European context should be one of the objectives of a regional strategy for on farm conservation of plant genetic resources for food and agriculture. Such a strategy will also concretely address the implementation of the article 6 on sustainable use of PGR of the ITPGRFA. We remind that this article is mandatory for Contracting Parties and is addressing to all the crops and not only to these listed in annex I, as for example in the case of the Multilateral System.

Moreover, it will ease the debate on Farmers' rights at regional and international level due to the fact that many actions included in article 6 are also in strict relation with article 9. The promotion of the use of local varieties and underutilised species can be considered a way of protecting of traditional knowledge (Article 9.2(a)). Increasing farmers' options through participatory plant breeding could be considered a non-monetary benefit sharing measure (Article 9.2 (b)). Therefore an integrated on farm strategy that includes informal seed systems and their varieties should consider the promotion of Participatory Plant Breeding (PPB) strategies to help farmers to fulfill their needs, facilitating them in accessing the genetic resources and broadening the range of available species all they are actions aiming to bring compensation in farmers' favor (Louwaars and Visser, 2002). For this reason article 9.2 (b) can be considered close to articles 6,2 (b) (d) concerned about research promotion, Participatory Plant Breeding and farmers' access to the genetic resources (Bocci and Chiari, 2009). Finally, promoting diversified agricultural systems (art 6.2a) through policies that support informal

seeds system will enhance farmers' role on seeds exchange, reuse and sell in agreement with article 9.3.
In this framework the on farm strategy should allow the presence on the market of proximity (local market or direct sell) of the varieties identified by FSO, To this goal the role of networks or associations could be a key element in order to set up a bridge between formal and informal seed systems. The latter, as already pointed out, is a specific system based on social norms: trust, reputation and reciprocity govern it. Therefore enhancing the role of social networks could improve the quality of informal seed system. At this regards, the directives on conservation varieties open a new interesting possibility, for the first time allowing organisations to have a role within seed legislation (article 34 of the directive 2009/145/CE and 21 of the directive 2008/62/CE). A specific attention should be paid in order to monitor the process of notification to the Commission of the recognised organisations.
Finally, we would like to stress the importance of such a strategy, also because "it is impossible to replace farmers' seed systems completely and it would be unwise to try. Farmers' seed systems provide an important component of food security, a vital haven for diversity and space for further evolution of PGR" (FAO, 2009).
Since the directives on conservation varieties have been already published, we will only summarise the limits of its applicability. For the populations varieties and farmers' varieties we will bring suggestions.

Task 4.4 (leader A. Caldarelli, AIAB) presented the results of all the project to the general public, in order to stimulate and support the citizens' ability of understanding such a specific matter and the possible consequences of different laws and regulations over the land management, agricultural sector, the crop research, production and consumption patterns at global and local scale up to the daily life and possibility of choosing between different market products by the single consumer. All the deliverables will be published on the project website, and spread through other media, such as websites, magazines. All the partners are involved. During the third year AIAB maintained and implemented the website, putting on it the different deliverables issued and updating its calendar with events relevant to the goals of the project. Each partner presented the FSO project in different meetings, workshops and conferences. During the three years the following papers were published:

R. Bocci, *Seed Legislation and agrobiodiversity: conservation varieties*, Journal of Agriculture and Environment for International Development 2009, 103 (1/2): 31-49

A. Osman & V. Chable, *Inventory of initiatives on seeds of landraces in Europe*, Journal of Agriculture and Environment for International Development 2009, 103 (1/2): 95-130

V. Chable & R. Bocci, *Peasant seeds in Europe: stakes and prospects*, Journal of Agriculture and Environment for International Development 2009, 103 (1/2): 81-93

Chable, V., Goldringer, I., Dawson, J. Bocci, R., Lammerts van Bueren, E.T., Serpolay, E., González, J.M., Valero, T., Levillain, T., Van der Burg, W.J., Pimbert, M., Pino, S & Kik, C. 2009. Farm Seed Opportunities: a project to promote landrace use and renew biodiversity. In: Veteläinen, M. V. Negri, V. & Maxted, N. (Eds). European landraces: on-farm conservation, management and use. Bioversity Technical Bulletin No.15. Bioversity International, Rome, Italy, pp. 266-274.