Possibilities and Reality of On-farm Conservation

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Abstract: Conservation of crops is based on *ex situ* collection into gene banks. Additionally, crop's wild relatives can be conserved *in situ*, and landraces and obsolete cultivars also can be conserved using the on-farm method. The definition and methodology of on-farm conservation is discussed. On-farm conservation has been set up in the Czech Republic as model examples in several institutions dealing with nature protection, education, cultural conservation, as well as by some private farmers. Problems, plus positive and negative experiences are presented. On-farm conservation in open-air-museums in the natur (skansens) as well as in the national parks, seem to be suitable ways forward for the Czech Republic.

Keywords: conservation; *in situ*; landraces; on-farm; plant genetic resources

Old landraces are among the most desirable materials, as they posses a wide range of genes useful for quality breeding, specialty uses, and their variability of characteristics. The best means of their conservation is if the materials are still available within the farming system. But except for rare cases, there are only several remaining traditional landraces presently in agriculture. However, there is a strong desire to return landraces from gene banks back to renewed life; to be grown on farms and to maintain them there in the so-called "on-farm" conservation system. Some gene banks have adopted the possibility of allowing farmers to regenerate landraces. In Hungary, in the nineteen-nineties, 500 to 600 landrace accessions were multiplied yearly under climatic and edaphic conditions similar to their places of origin (Már & Holly 1998).

The economic environment of the farm household significantly determines the extent of genetic diversity in agriculture. Economic development predominantly had a negative impact on agricultural diversity, and hence on conservation. The idea of increasing (or attaching importance to) the value of old cultivars, can promote their growth and make diverse agriculture more competitive, relative to modern intensive cultivation (Goeschl 1998; Jarvis 1998).

Definition

On-farm conservation is the sustainable maintenance of landraces and obsolete cultivars (lines, populations) by growing them in conformity with environmental conditions; additionally, using growing technologies close to the conditions under which these materials had originated and evolved. This dynamic conservation enables the development and evolutionary continuation of materials under the influence of the regional environment and the technologies used.

Maxted *et al.* (1997) defines on-farm conservation as the "sustainable management of genetic diversity of locally developed landraces with associated wild and weedy species or forms by farm-

ers within traditional agriculture, horticulture or agri-silviculture systems". Maxted *et al.* (2002) distinguished two categories: (1) the conservation of genetic diversity within a particular farming system or (2) the conservation of the traditional farming system itself. The introduction of a certain percentage of high-yield varieties to a traditional farming system may sustain the farming system at that location, but could lead to gene replacement; and therefore to a genetic erosion of the original landrace material (Maxted *et al.* 2008). It is important to consider the pollination systems of the crops. Even self-pollinated crops have, to a certain extent, open pollination in unfavourable meteorological conditions.

MATERIALS

Landraces and obsolete cultivars are treated separately. Landraces originated from the selection of wild-growing ecotypes and their cultivation by farmers in their home regions. Farmers repeated both positive and negative selection, until the landraces become stabilised, and these are swapped among each other. Obsolete cultivars originated on a professional basis among early breeders; at first by conscious selection, and later by intentional crossing. The boundary between these farmers' and breeders' materials is not a clear one. They are often a combination of the above. Real landraces are exceedingly few in number, and correspondingly, only limited information has been saved about them compared with the older bred cultivars.

Crop use in on-farm conservation

On-farm represents the return of landraces to cultivation in the regions of their origins, or their long-term traditional growing. Use of the method is limited, especially due to economic and/or market problems. The crop must be self-sustaining in the market or subsidized. In the past, under the then poor economic situation, there was no place for on-farm conservation in Czechoslovakia. At present, with the changing of agricultural priorities, the market is opening up for interesting traditional materials; especially in connection with organic farming, the rise in demand for both vegetarian and health foods, as well as the demands for the diversification of species and crops. In the case of fruits, landraces are undergoing a great renaissance; mainly for their use in special marginal conditions. They possess good yield stability, higher resistance to pests and diseases, and low growing demands. The optimal situation is when the crop keeps its traditional use, for which it was bred, cultivated and valued (e.g. Carpathian emmer wheat, *Triticum dicoccon*, was used for making groats for blood sausages and for soups, for which it was irreplaceable). The use of a crop in its fresh state is usually very economically valuable. A respectable profit is possible if the crop is used for industrial processing for certain valuable compounds, such as valuable nutritious or medicinal compounds (vitamins, non-saccharinous sweeteners, dietetic compounds, therapeutic factors, for special diets, food additives, etc.).

The changing of agricultural priorities also brings new requirements for crops. Alternative utilizations of crops (e.g. for non-food products) requires the breeding of new characteristics, and brings a demand for new genetic resources. Thus, old landraces can achieve new, non-traditional uses.

Growing conditions

Landraces and obsolete cultivars should be grown under conditions similar to the original ones. It is important to avoid selection pressures resulting in genetic drift.

Farmers running on-farm conservation should grow landraces in smaller fields and carefully use mechanization which does not affect selection (e.g. does not prefer rounded or larger seeds).

Self-sustainable system

The resulting yield/product should be economically profitable in the marketplace, in order to pay for the usually higher costs of growing. It is economical to connect such growing with organic farming technologies. Products of bio or organic quality can be marketed at higher prices, enabling the farmer to cover the higher production costs. It is very important to establish vertical integration from growing to marketing in the case of food products (e.g. stores and restaurants offering healthy nutrition, organic/biodynamic products, old country life, etc).

European and Czech reality, other possibilities

It is not easy to initiate the running of a profitable system for growing historical crops, including guaranteed on-farm conservation. It requires the correct background, an economically strongly traditionalist society, with strong connection to past habits. Such a system has already been running successfully in Italy for many years (Valeria Negri, personal communication), and also in other European countries such as in Germany, France, and Portugal; where there is a demand for traditional crops, and such production has been carried out for decades. A good example is the cultivation of lavender (*Lavandula officinalis* Chaix *et* Kitt.) based on historical cultivars, and products made of regional lavender in the south east of France.

In the Czech Republic, there are also producers of agricultural bio-products and bio-food (called organic or biodynamic) products. However, their producers behave economically, often using old foreign cultivars, already existing in the western European markets. It is no wonder that on-farm conservation is not their priority, nor their motivation. They grow only those crops that bring in an economic profit.

Private farmers growing landraces often do it either as a hobby or out of enthusiasm for their own use. Their connection to broader on-farm projects is very desirable. They usually have a good overview and practical knowledge; although, their successful engagement requires financial support, it primarily helps with marketing.

There are also other possibilities of how to ensure on-farm conservation, and those are those institutions dealing with nature and plant conservation, education, and public awareness:

- National parks (NP), Landscape Protected Areas (LPA) and other institutions for environmental protection.
- Regional museums and skansens (open air museums).
- Secondary schools and universities – programs in agriculture, horticulture.

These institutions can run on-farm conservation projects as part of their presentations for the public, as well as for internal educational purposes.

Implementation conditions

- Signing of a protocol between the seed provider (gene bank) and the grower.
- Setting up the conditions for keeping the culture and seeds clean and unmixed.
- Agreements for fields to be checked during vegetation by the seed provider.
- Elaborating of the economic conditions (autocompatibility of the system or starting subsidies from the seed provider or other entities, or even automatic financial subsidies)
- Minimum time limits for the agreements.

Model examples of up-and-running on-farm conservation in the Czech Republic

Several attempts have been made to set up at least temporary on-farm conservation. While on-farm conservation of fruit trees seems to be very successful and long-term (Paprštein *et al.* 2009), the system for herbaceous plants is not as certain. When an orchard is set up, it needs to be maintained, although the threats of mistakes and mixing are minimal; whereas the mixing of herbaceous crops is quite undesirable.

The following institutions/persons have accepted seeds and agreed to the running of on-farm conservation:

- Ponikva, a regional organization, Czech Union of Nature Conservationists
- Moravian Karst PLA
- Walachian village, Walachian Museum in the wild, Rožnov pod Radhoštěm
- Zubrnice Skansen (open air museum)
- White Carpathians LPA, and a private farm within this region
- Šumava NP and LPA
- Krkonoše NP
- Podyjí NP
- Private farmer J. Mencl

Materials for running on-farm conservation

Several typical landraces, known from various regions, have been selected for *in situ* conservation trials:

(1) Emmer and einkorn wheat (*Triticum dicoccon*, *T. monococcum*) – landraces from the Czech-Slovak border (Small and White Carpathians).
(2) Perennial tufty rye (*Secale cereale* var. *multicaule*) – original material from historic stocks in the Research Institute for Fodder Crops, Troubsko.

(3) Grass pea (*Lathyrus sativus*) – landraces from the Czech-Slovak border (Small and White Carpathians).
(4) Black pea (*Pisum sativum* var. *medullare*) – landrace from Beskyd Orawski, Poland.
(5) Beans (*Phaseolus vulgaris*) – two Moravian cultivars.
(6) Medicinal plants and condiments (tarragon – *Artemisia dracunculus*, calamint – *Satureja hortensis*, mint – *Mentha piperita*, and oregano – *Origanum vulgare*)
(7) Shallot onion (*Allium ascalonicum*) – two landraces from the Chodsko Region (Western part of the Czech Republic)
(8) Red cabbage (*Brassica oleracea* var. *capitata*) – very prominent landrace Vysocké, with long heads from the Krkonoše Mts region (Northern part of the Czech Republic).
(9) Lettuce (*Lactuca sativa*) – landraces Valašský and Valašský universal from the Walachian region (Eastern part of the Czech Republic)
(10) Fruit trees – apples, pears, cherries, plums, and rowan (Krkonoše Mts, Šumava Mts, Orlické hory Mts, and Podyjí)

Most of the materials mentioned above have been tried in more than one site; vegetables were only given to one place, strictly according to their origin. We consider that the most valuable conservation takes place on private farms of enthusiastic farmers, such as Mr. Mencl. He has been growing red cabbage Vysocké on-farm for several years.

Another partly successful, but short-lived, example was in the White Carpathians. Five emmer wheats, of Carpathian origin, were selected from the Gene Bank in Prague and sent to the administration of the White Carpathians LPA. They were grown for one year in the field under LPA administration (I. Jongepierova). Two of these were selected and given to a private farmer, neighbouring on the LPA. He grew them for two years with subsidies from the Gene Bank. The landraces were grown in the traditional manner in row fields. However, he did not find market success for his products, and he sent the regenerated materials back to the Gene Bank.

Selected fodder legumes, grass pea (*Lathyrus sativus*) and black pea (*Pisum sativum* var. *medullare*) were evaluated and regenerated at the Research Institute for fodder plants in Troubsko, and were then sent to a private farmer, together with subsidies. In a similar way, this project failed because of the lack of the product's economic success.

Better results with running on-farm conservation have occurred in skansens and national parks. The Walachian Museum keeps received materials of vegetables and grasses, Zubrnice Skansen keeps the grass pea and herbs, and Šumava National Park keeps shallots.

CONCLUSIONS

While on-farm conservation moves along routinely in some European countries, in the Czech Republic only model examples have been brought to life for one, two, or more years. Self-sustainable production/conservation on a private farm has not yet been successful. There is a promising future for running on-farm schemes for education, as well as for demonstrations for students and the public at institutions like schools, national parks, museums, etc. The methodology for on-farm conservation has been detailed and elaborated upon.

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