Section for Agriculture – Goetheanum
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Seed as a Commons

Breeding as a source for real economy, law and culture

Assessment and future perspectives
for non-profit seed and breeding initiatives

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Preface

«Seed is a commons!» This slogan emerged a few years ago as a reaction to the expansion of power in the fast growing seed industry, in particular regarding the patenting of plants. Is this slogan only an emotional outcry or is it a viable proposition? This question was the starting point of this study – how can seed and the breeding process be legally and economically understood and handled in a way that «common good» comes into effect in the best sense of the word?

A range of varieties for organic farming and horticulture has been created in the last three decades based on anthroposophical and biodynamic breeding research. The authors, a biologist, a breeder and a farmer, know that the realization, breeding and cultivation of crops require a substantial personal commitment. This commitment takes place in the public social sphere as well as in the open biological environment, i.e. includes the opposites that are mutually dependent, namely the individual and the universal. A practical common property economy should do justice to both.

For a long time we have been struggling with the question of who represents the users of the common pool resource for seed. The term «user community» is central in the common property science of Elinor Ostrom. Through responsible and sustainable use, it is the actual creator of the material common property. In the case of seeds of crops, the source of sustainability can be found only in the future, in development. To this end, what is required is not a static user community but a diverse and project-related community which allows for concrete future development stages. These are supported by development funds of representative organizations of public values and goods.

During the course of the conceptualization of the social positioning of seed, it was important to realize, that each seed package always contains an economic, legal, and cultural property. Seed is part of the real economy and goes beyond mere exchange or purchase from one owner to the next until it is sown. Seed as a variety is a legal property of a non-material nature, with rights and obligations for the owner and the user, depending on how the rights apply.

This variety, in turn, can be bred only if the breeder has access to all available seeds during the cultivation of this plant variety. What is decisive now for a practical handling of seed as a common property is that the three properties – economic, legal and cultural – are differentiated and that there are transparent transitions between them.

In practice, there exist different concrete solutions for this principle.

The study addresses breeders, plant breeding researchers and the whole organic seed industry. With the present paper, we would like to contribute to a constructive dialogue among the people who are involved in this area. Furthermore, we also address farmers and gardeners since they are the most important partners of the breeders. Our study is also for the foundations and sponsors who we hope will maintain their commitment. We also address the associations and companies in the organic sector with the call to action, in one form or another, to participate in the sponsorship of seed as common property. Last but not least, we would also like to support and inspire the political actors in the north as well as in the south in their aspirations to create open source conditions for the production and use of organic non-profit seed.

Breeding nursery, Getreidezüchtung Peter Kunz, Feldbach, 2015

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Glossary

ABS – Access and Benefit Sharing
ABDP – Association of biodynamic plant breeders
AFSA – Alliance for Food Sovereignty in Africa
ARIPO – African Regional Intellectual Property Organization
BDP – German Plant Breeders' Association
Bio Suisse – Umbrella organization of 32 organic farmers' associations
BLW – Federal Office for Agriculture (Switzerland))
Breeder privilege – Breeders can use protected varieties as starting material for the development of new varieties
BSA – German Plant Variety Office (Germany)
CGIAR – Consultative Group on International Agricultural Research
CBD – Convention on Biological Diversity
CBR – Community Biodiversity Register
CMS – Cytoplasmic male sterility; is often transferred from one species to another by cell fusion techniques
CMS-Hybrid – Hybrid which is produced by the male sterility inherited from the cytoplasm of the maternal line
COMESA – Common Market for Eastern and Southern Africa
EBA – Enabling the Business of Agriculture
An initiative of the World Bank
ECO-PB – European Consortium for Organic Plant Breeding
ESS – Ecosystem achievements (Switzerland or Germany)
ETHZ – Swiss Federal Institute of Technology Zurich
family farmers – Familien-Bauern in German
FAO – Food and Agriculture Organization
Farmer's privilege – Using crop of a protected variety for own use (reproduction)
FiBL – Research Institute of Organic Agriculture
GAP – Common agricultural policy
Gene pool – All the gene variations of a plant variety
Hybrid variety – Crossbreed from two to four parents
IAASTD – International Assessment of Agricultural Knowledge, Science and Technology for Development; World Report
IAD – Institutional Analysis and Development framework
IFOAM – International Foundation for Organic Agriculture Movements
ITPGRFA – International Treaty for Plant Genetic Resources for Food and Agriculture
LDC – Least Developed Countries
Line variety – For uniformity selected variety of self-fertilizer
MEA – Millenium Ecosystem Assessment
MLS – Multilateral System

NAFTA – North American Free Trade Agreement
NAP(-PGREL) – National Action Plan (To promote plant diversity in the field)
NP – Nagoya Protocol
Organic seed – Seed propagated during at least one propagation cycle under ecological cultivation conditions
Organic variety – Variety propagated from the start under ecological conditions
OSSI – Open Source for Seed Intitiative
PGREL – Plant genetic resources for food and agriculture
Population variety – Propagation material of genetically heterogeneous external or self-pollinators
PPB – Participatory Plant Breeding
Pre-breeding – Maintenance of a gene pool: Development of a range of new and old varieties as the basis for a subsequent cultivation of varieties
Reproduction – On uniformity selected variety of self-fertilization
Rio Convention – See CBD
SICASOV – Société coopérative d'intérêt collectif agricole des sélectionneurs obtenteurs de variétés végétales
Company for representing the interests of plant breeders in France
SMTA – Standard Material and Transfer Agreement
UNCED – United Nations Conference on Environment and Development
UNEP – United Nations Environment Programme
UPOV – Union internationale pour la protection des obtentions végétales
International Union for the Protection of New Varieties of Plants
UPOV criteria – ***1. Distinctness:*** The variety must be different from all known varieties
2. Uniformity: The variety can be described as a unit, and can therefore be distinguished from other varieties.
3. Stability: The uniformity of the variety remains after a propagation cycle.
Variety protection – Temporary right of ownership for the propagation of seed from a variety recognized as new, uniform and consistent

Summary

The present study shows the importance of the commons seed and describes ways of its conservation and sustainable development.
We show what prerequisites must be met for plant breeding for the common good in Europe and what conditions must be fulfilled to protect plant varieties in developing countries from further erosion.

First of all, it is about the production of food in organic agriculture in the north and about food sovereignty in the south. These issues show the complex changes of global structures and values in agriculture and nutrition, which affect all of us in one form or another. Tools are proposed to tackle the enormous challenges of global food security, climate change, seed monopolies and the threat of losing crop species.

The study includes four parts.
Part A deals with the **current situation of agriculture and horticulture** on a global scale. The conclusion is unequivocal: the worldwide loss of agricultural biodiversity is the result of a production process that generates maximum yields with the massive deployment of fertilizers and crop protection products at the expense of environment and human health – an approach that is not needed. On the one hand, there are enough kilocalories generated today to feed a world with a population of 14 billion people if not more than half of the primary production were not being destroyed. On the other hand, the Food and Agriculture Organization of the United Nations (FAO) has shown that 70 to 80 percent of the world›s food is still produced by family farmers of which more than 80 percent cultivate a maximum of two hectares. Stabilizing and improving this production must therefore be a top priority.

In addition, the FAO's extensive efforts with the International Seed Treaty (ITPGRFA) and the United Nations Environment Program (UNEP) with the Convention on the Conservation of Biodiversity (CBD and Nagoya Protocol) have not been able to stop the loss of global (agro) biodiversity. The issue of food security is directly linked to the availability of seed. As in the developing countries, seed was a common property in the industrialized countries up to 100 years ago. Since then, seed has undergone a dramatic commercialization and privatization process. This process is also in full swing in the developing world, considerably affecting food supply and food sovereignty. The seed purchase not only makes a lot of farmers dependent on seed companies, but at the same time leads to the loss of the traditional adapted varieties and thus of agro biodiversity.

Part B explores how **common property or common pool resources** must be organized and managed so that they can be sustained for a long time and for many generations. This scrutiny is based on the work of the first Nobel Prize laureate for economics, Elinor Ostrom. She has demonstrated clearly how successful common property user communities (commoners) have been organized in the past and today. As often as Ostrom is cited in the commons movement – from open source software, to community projects in cities and municipalities, to agriculture, water supply, fisheries and economic theories – the «design principles» which she has identified for sustainable use of common property are rarely discussed. They are still inspiring and provocative even after more than twenty-five years since their first presentation.

While depletion of natural resources is always a major concern, seed is characterized by the fact that it is lost only when not used anymore! That was and still is the main reason for the alarming worldwide decline in agro biodiversity.

The work of Elinor Ostrom gave reason to address the subject of seed and breeding from the perspective of the commons. However, it soon became clear that the transfer of the usage architecture of public domain natural resources such as water, pastures or fishing grounds to the conservation, utilization and breeding of seed and varieties is far from trivial. While depletion of natural resources have always been a concern, seed is characterized by the fact that it is lost only when not used anymore! That was and still is the main reason for the alarming worldwide decline in agro biodiversity.

Seed and crop varieties are associated with three different societal-social spheres. First, they are an **economic or exchangeable commodity** that is sold or passed on in the form of grains, seeds, cuttings or tubers. The same seed also forms a **legal interest as a variety**, whose use is regulated and protected in most countries of the world. Furthermore, it is also a fundamental **cultural product and cultural heritage** – similar to literature or music – which is dependent on the creativity, the perseverance and experience of a breeder or a breeder community. While the first sphere is still anchored in social consciousness, the second, and even more, the third, are prone to disappear. Modern molecular genetic methods are mostly overestimated and are of little relevance for the development of complex properties such as salt tolerance or drought resistance (See e.g. Gilbert 2014). Biodiversity is a result of the common evolution of man and nature (Vavilov 1932).

Part C addresses **ecological breeding in Europe**, which originated in the biodynamic movement and aspires to contribute to sustainable agriculture, biodiversity and food sovereignty. The spectrum of initiatives is wide and differentiated according to the objectives set by each. Most of them are organized as non-profit associations and thus show their closeness to common property and common good. Some initiatives are breeding for professional cultivation on a very high standard and in close interaction with their users. Others are

Biodiversity is a result of the joint evolution of man and nature.

concerned with the development of traditional cultivars and the conservation of traditional crops for agriculture and horticulture. Some projects involve participatory breeding with cooperation between scientists and farmers.

As in the objectives, the initiatives also differ in their social, political, legal and economic embeddedness. One of the major challenges for future development is to ensure the funding of future breeding activities. The requirements are particularly high when cultivating varieties for commercial organic farming, since quality expectations for organic raw materials and market products are higher and the cultivation conditions more demanding than in the corresponding conventional sector.

Regarding the fact that nowadays only one to five percent of the varieties for organic farming are derived from ecological farming, we face an enormous challenge. In contrast to the practice of organic propagation of conventional varieties, the vision of using one hundred percent of seed from ecological breeding, as is being discussed in the ongoing revision of the EU organic regulation, is desirable but can hardly be implemented at present.

The importance of non-profit breeding initiatives can be justified historically and in principle. Historically, they are the continuation of the work of user communities through which the whole variety of crops has developed. In principle, breeding includes the following three elements: the regular reproduction and the selection of varieties, their distribution during periods of migration and the free exchange of seed among the different user communities as has been the case over the last 10,000 years across all continents.

With the help of examples, non-profit ecological breeding initiatives are presented together with their rights and obligations:

- They breed many crop species and varieties for professional cultivation and hobby gardening. To meet the expectations of their customers, the intensity of the breeding, the methods used and the handling of the registration and the protection of their varieties can be very different. It appears that all forms of use, registration and ownership of varieties, as long as they are not patents, are compatible with the idea of common property and their user communities.
- The size of the user community is an important factor. On the one hand, it should be manageable because personal contact and familiarity create trust. On the other hand, it is a working hypothesis that, in the case of varieties for professional cultivation, all parties involved from the farmers to the entire downstream value chain, including the retail trade, can be considered to be members of the user community.
- Ecological breeding contributes to a significant extent to the optimization of the achievements of ecological production and thus to other subsistence commons. Ecologically bred varieties can cope with the nitrogen available

in the soil, so that air and water are not polluted with artificial fertilizers. The varieties are open pollinated, i.e. self-propagating, and thus contribute to the increase of agrobiodiversity. Because production is not dependent on herbicides and pesticides, they support the ecosystem services of the biological and biodynamic producers for the benefit of the environment and health.
- The political request to use in the future only ecologically bred varieties in organic farming is an ambitious goal which can be achieved only with the material and ideal support of national and international government agencies. The financing of ecological breeding is not possible solely through the sale of seed or through licensing fees for locally adapted regional varieties.
- Funding concepts and financial systems of non-profit plant breeding must relate to the users and their responsibility for both executive action and costs.

Future scenarios in industrialized countries

- Of central importance is the geographical expansion of breeding activities beyond German-speaking regions.
- For this, the training of future responsible breeders will play a prominent role.
- Key factors for success are the differentiation, rationalization, co-ordination and interlinking of the activities as well as cooperation with new partners.
- Public relations activities aimed at the authorities and for promoting research and training centers must be expanded.
- Ecological breeding improves the quality of products, as well as the raw materials for the value-added chain. Therefore, models for financing should involve all partners in the chain and the farming associations. For the former, a one tenth of a percent fee on all fresh products is proposed, the latter could contribute with a steering and incentive tax.
- Ecological breeding makes contributions to other commons. Since agrobiodiversity and ecosystem services are highly subsidized by governmental agencies the promotion of non-profit ecological breeding initiatives with money from these institutions is justified.
- The contribution of foundations is large and will remain so. Donors must recognize that breeding projects are always designed for cycles of 10 – 15 years, and therefore dependent on long-term commitments of funds.

Part D analyses the **situation of plant breeding in developing countries**. Here, breeding, seed propagation and cultivation are largely provided by the producers and production communities. In this way, agrobiodiversity is maintained to a large extent regionally and in some cases also newly created. At the same time, the challenge is to develop the traditional varieties quickly and effectively in the course of climate change, dwindling soil fertility and the partly low yields. This challenge has to be met in a difficult political environment and under the most difficult economic conditions. The rural communities are fragile, suffering from too few financial resources and often marginal recognition by governments and the international community.

Seed as a commons is dependent on user communities with structures, as has been detailed by Elinor Ostrom.

As a vision, we are proposing to actively create new seed and breeding communities as a third pillar alongside the international contracts (CBD and Nagoya Protocol, as well as ITPGRFA) to preserve agrobiodiversity.

Available instruments and recommendations for action

- Food security and preservation of agrobiodiversity depend on a true assessment of the global costs and benefits of food production. As Sukhdev et al. (2016) emphasize, neither the maximization of the yields or profits per unit acreage nor the orientation towards the gross domestic product is suitable for this purpose. The one-sided reference to these two parameters obscures problems that are caused by high-yield agriculture. The authors estimate that high yield agriculture accounts for 60 percent of biodiversity losses, 24 percent of greenhouse gas emissions and 33 percent of the deterioration in soil quality. Last but not least, in many developing countries as well as in industrialized countries, there is not only undernourishment but also malnutrition, both resulting in rising healthcare costs.
- Nutritional sovereignty and agrobiodiversity depend on due consideration for farming communities. Their representatives must therefore be included in all negotiations where land sales to foreign investors, free trade zones and changes to seed laws are discussed and implemented.
- The recognition of traditional agriculture is essential for food sovereignty, agrobiodiversity and ecosystem services.
- The establishment of user communities that set their strategic and operational objectives and rules themselves, monitor their compliance, and punish non-compliance is dependent on recognition by the international community and national governments. Both support the formal establishment of such communities.
- On all continents, prototypes of user communities are developed for this purpose.
- In addition to their other activities, non-governmental organizations also contribute to the formation of user communities and the concrete formulation of the design principles identified by Elinor Ostrom.
- Together with farmers, they work out a monitoring system with which successes, problems and challenges can be recognized at an early stage. They support the actors in the further development and adaptation of these principles.
- Governments and authorities recognize, in addition to international treaties, this third form of protection for agrobiodiversity and provide the necessary legal and political freedom.
- In turn, the user communities undertake, with the support of many partner organizations, to intensify their cultivation methods permanently, to develop their crops continuously, to ensure seed storage and documentation,

and to make their experience and knowledge available to other communities in a suitable format.

- By intensifying production, the existing crop species and varieties must not be destroyed. The support of traditional sustainable practices with locally adapted varieties is recognized by governments and international organizations as the key to achieving this.
- The economic existence of farmer communities must not be threatened by imports of food from industrialized countries. On the contrary, such communities should be supported in exporting any surpluses to other countries. ■

The vision provides a perspective in which , in addition to the international treaties for the preservation of (agricultural) biodiversity (CBD and Nagoya Protocol as well as ITPGRFA), seed and breeding communities are actively being created as a third pillar.

A. The actual state of agriculture – The worldwide loss of biodiversity continues unabated

1. Global challenges for food and agriculture

Proposals for solving the world's hunger problem and for the future safeguarding of food supplies for a growing world population are based on two assumptions. Firstly, sufficient food supplies for all people can be achieved only with an intensification of agricultural production and an increase in yields (Alexandratos and Bruinsma 2012). Secondly, it is assumed that the prices for food must decrease (Pollan 2006). Linking these assumptions results in a dynamic that can function only with unlimited resources.

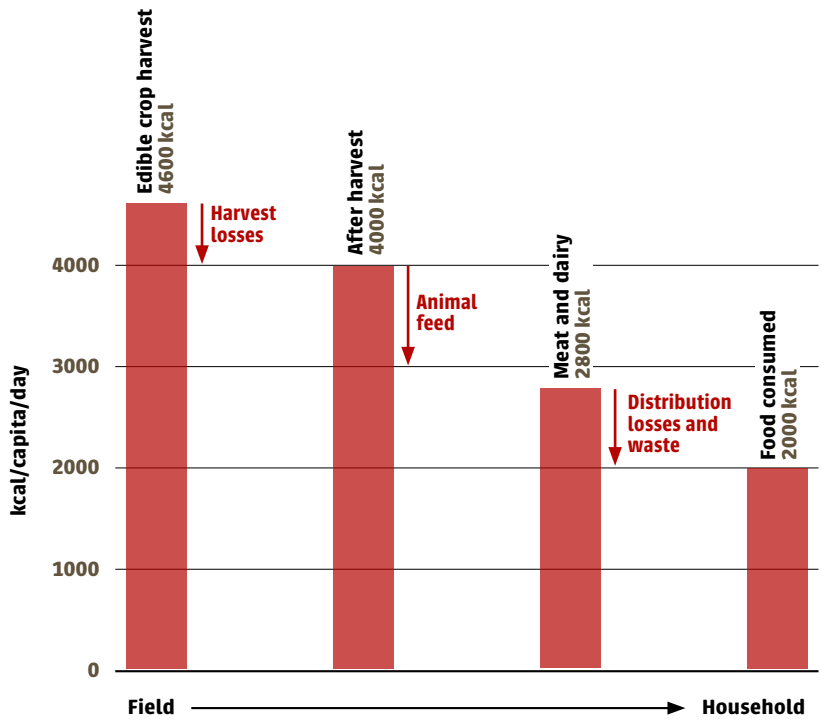

Figure 1a:
The global production of food (In kcal per capita and day) and the reasons for their reduction (From UNEP 2011, modified).

The intensification of production increases the supply; given that the demand remains the same, prices will drop. As a logical consequence, demand must be increased, which in turn leads to an increase in production, etc. This vicious circle is based not only on false assumptions, but also on a conclusion that is unconvincing.

Food for 14 billion people is grown worldwide

According to a study by the UNEP (2011), 4,600 kcal of food are produced daily for each person. If one assumes a daily requirement of 2,000 kcal, this quantity would have been sufficient for not just seven but more than fourteen billion people (Fig. 1a and 1b). Due to several factors, more than half of the output of primary production is lost. Losses result from insufficient storage – especially in the developing and newly industrialized countries. By feeding cows, pigs and poultry to meet the growing demand for meat products, 2,800 kcal remain. Finally, expiry dates of products in supermarkets and «food waste», the disposal of food as garbage – mainly in Europe and the USA – reduce the available quantity to 2,000 kcal per capita and day. The demand for a permanent increase in the yield of agricultural production, if it could be fulfilled, would not solve the problem of feeding the world. The need can be justified only by the assumption that today's food habits in industrialized countries are copied in all other countries (FAO 2009a).

The demand for a price reduction for food misses the target of a sustainable preservation of the world's food. A study by the London School of Economics and FiBL Switzerland estimates the annual losses caused by food waste – for the most part in the industrialized countries – to be around 2.6 trillion dollars or four percent of the global gross domestic product (FAO 2014 a).

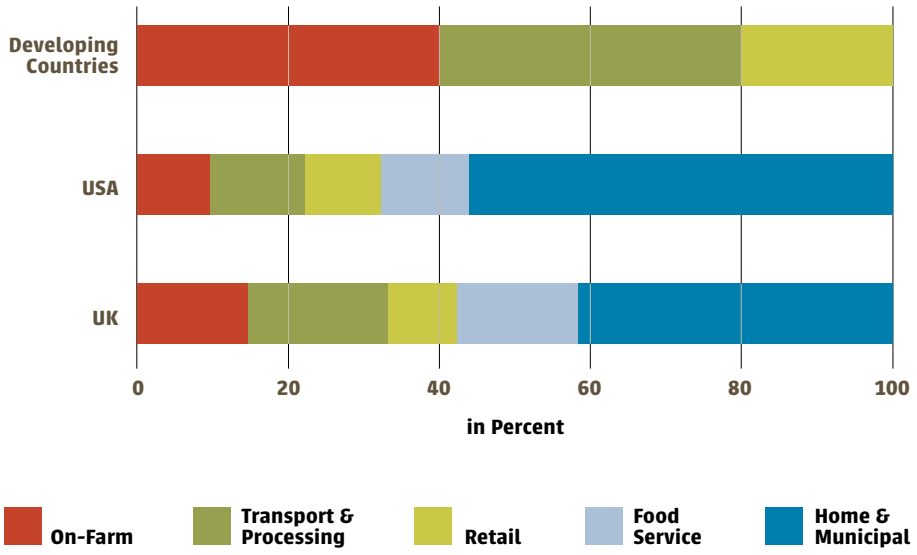

Figure 1 b:
The causes of losses in developing countries (top), the USA (middle) and the UK (bottom) (from UNEP 2011, modified).

These figures are to be viewed with caution, since a whole series difficult to verify assumptions had to be made. However, they are a clear indication that the low value of food leads to this irresponsible waste. In an otherwise utopian scenario the production volumes could be halved. At the same costs for consumers, the producers could double their prices and thus generate the same revenue. The intensity of production could be reduced – for the benefit of people and environment.

World hunger and food sovereignty are not necessarily linked to agricultural productivity, but are due in the short term to the problem of storage in the developing countries as well as to the dumping prices in the developed countries. Therefore, the primary focus of efforts should be not on a further increase in yields, especially if they are linked to the degradation of ecosystems and agricultural ecosystems, but rather on maintaining the current productivity level while reducing losses as much as possible.

The most important challenges for safeguarding food are the greening of production and the preservation of crop variety. Those challenges are as closely linked as the intensification of production and the falling prices of food. This applies to both developing and industrialized countries.

Agricultural production is concentrated on a declining number of arable crop species and is increasingly dependent on high-yield varieties. According to the FAO, 60 percent of global food is accounted for by only three crops: wheat, corn and rice (FAO 2004). High-performance varieties result in improving agricultural production which is unthinkable without increasing the concomitant use of artificial fertilizers and chemical plant protection products, and thus entails considerable environmental and health implications. They also enhance the dependency of farmers on seed crops globally, since production costs are rising as a result of the higher seed prices without the corresponding increase of the price for the products. Finally, intensive agriculture not only replaces traditional cultivation systems, but also destroys agrobiodiversity, in particular the variety of crops and their varieties.

The greatest challenges for safeguarding the food supplies are the greening of the production and the maintenance of the range of crop species.

According to FAO, approximately 75% of all agricultural crops and varieties have disappeared in the past hundred years (FAO 2004).

2. The role of large seed companies

> «National food supplies globally
> have become increasingly similar in composition,
> based upon a suite of truly global crop plants.»
> Khoury et al. 2014

Since the middle of the last century, climate has been only to a small extent the reason for biodiversity loss. The erosion of diversity is a direct result of the use of high-yield varieties and the concentration of seed production in a few corporate groups. The seven largest seed multinationals (Monsanto, Pioneer, Syngenta, Dow, Bayer, BASF, DuPont) expand by taking over other seed companies around the world (Howard 2009). Bartha and Meienberg (2014) point out that in 2012 more than 60 percent of the global seed market was dominated by only nine companies. By 2016, the situation had worsened: the two US companies DuPont and Dow wanted to merge, ChemChina wanted to take over Syngenta, and Bayer planned to take over Monsanto. With these mergers, the three new companies would dominate more than 60 percent of the global seed and agrochemicals market (Moldenhauer and Hirtz 2016). This results automatically in a homogenization of the global food supply with major implications for food security (Khoury et al. 2014). This concentration in the seed market will also destroy the genetic resources, the «capital» for the future development of crops.

According to the FAO, about 75 percent of all agricultural crops and varieties have disappeared in the past hundred years (FAO 2004).

Crop	Country	Reduction of diversity
Melons	Spain	97 percent loss since 1970
Rice	China	90 percent loss since 1950
Corn	Mexico	80 percent loss since 1900
Rice	India	90 percent loss since 1900
Fruits and vegetables	USA	90 percent loss since 1900
Apples	Germany	99.4 percent loss since 1900

Table 1:
Examples of losses of varieties in various countries (Crop Trust 2014).

The selected examples show how dramatic the reduction of agrobiodiversity is in Europe and the US. (Table 1, Crop Trust 2014). Fewer and fewer varieties are grown on larger and larger acreages. There are many more examples: in India, only 10 varieties are grown on 75 percent of the rice fields. It is assumed that before the colonization by the British, there were some 400,000 varieties and until the middle of the 19th century there were still 30,000 varieties (Ceccarelli 2012). In the USA, on 71 percent of the cultivated acreage there are only six different varieties of corn grown. As regards wheat, there are only nine varieties on half of the acreage. 96% of the commercial production of peas entail two varieties (Muir 2013). This genetic homogeneity aggravates the problems of cultivation, since lack of varieties promotes the spread of plant diseases and therefore a growing use of pesticides.

3. Problematic breeding techniques

Hybrid varieties

The key technology involves hybrid varieties and is the best business model for seed companies. They have a built-in technical variety protection, since reproducing them is of no interest to the user, even in case of a species such as corn which is very easy to reproduce.

With the use of hybrid varieties, the traditional diversity disappears from the fields in the breeding nurseries and stores of companies. The common property is privatized.

Due to the inevitable genetic segregation, offspring are unstable and exhibit a lower performance. For hybrid varieties, inbred lines are obtained first from unrelated parent plants by artificial self-pollination between four and six times. Cross-combinations with highest yields are determined. Each year, the best combination is sold as a one-time seed to farmers and gardeners. With the use of hybrid varieties, the traditional diversity in the fields disappears from them and ends up in the breeding nurseries and gene banks of the companies. Common property is thus privatized. For example: for the last 50 years corn cultivation in Europe has experienced an enormous boost. Due to hybrid breeding, which was strongly supported by academic research, the ultimate northern latitude for cultivation of corn, which originally needed warmth, moved northwards by up to 1,000 kilometers. During the course of this development, all genetic resources for the cultivated varieties have ended up as the assets of the remaining five companies. There, this capital – actually a common property or a cultural property of mankind – is carefully guarded, because hybrid corn seed is worth as much as between 70 and 100 euros per hectare. It comes as no surprise that these seed companies are more resistant to crises than banks.

It took a project of the non-profit Fund for Crop Development in Switzerland to make this hidden gene pool accessible to the public again. From more than 200 hybrid varieties of different companies, a new non-hybrid, open pollinated population with the designation OPM.12 was created. This seed is freely available; every farmer and every breeder may work with it.

CMS hybrids

CMS (Cytoplasmic Male Sterility) is another technological fix for privatization of genetic resources. Loss of diversity and the exclusion of the global breeders' community from accessing genetic resources is the consequence. The CMS technique is based on pollen sterility inherited exclusively by the seed mother-plant. By using CMS innumerable hybrid varieties are introduced to the market today which do not form pollen and are therefore worthless for further cultivation. This technique is a one-way street. The breeding company acquires a monopoly on the genetic resources it collects, while it has access to all varieties around the world thanks to the recognized breeder's privilege. The CMS properties are transferred from one variety or even plant species to another by means of cell fusion techniques, which are forbidden in ecological

plant breeding. For many hybrid varieties of vegetables, CMS is standard. The ecological vegetable growers have therefore launched an initiative for worldwide collections of non-CMS seeds to save the diversity of varieties of as many vegetables as possible.

Genetically modified crops

In 1996 in the USA, the first crops were modified by genetic engineering and released for commercial cultivation. In terms of acreage the most important are corn, soybeans, canola, cotton and sugar beet. To date, only two properties have been incorporated into these cultures: Herbicide tolerance for the most frequently used glyphosate and / or resistance to pests (a plant-produced toxin from *Bacillus thuringiensis*). With two legal tricks, the doors were opened for the cultivation of these plants, especially in the USA. Based on the principle of «substantial equivalence», i.e. the claim that these plants are the same as the non-genetically modified plants as regards their composition, which is certainly incorrect, the products from these crops can be sold without labeling. With patenting, the companies that market genetically modified crops get comprehensive property protection. Their reproduction by farmers and the use of such varieties by other breeders are forbidden.

By patenting, the companies that market genetically modified crops are granted comprehensive property protection.

According to the ISAAA, an organization supported by the agri-biotech lobby and the US Department of Agriculture, more than 170 million hectares of genetically modified crops were grown in 2015 (ISAAA 2015). They cover over 90 percent of the acreage is in the USA, Brazil, Argentina, India and Canada. This figure might look impressive, but it accounts for only 3.6 percent of the world›s agricultural land. As regards Europe, genetically modified field corn is grown on fewer than 50,000 hectares in Spain, Portugal, Slovakia, the Czech Republic and Romania. There are various reasons for this small cultivated acreage. Firstly, the vast majority of the European population is very critical of GM crop production. Secondly, the products must be labeled. Thirdly, due to the precautionary principle, only a few GM varieties have been approved for commercial cultivation.

Genome Editing

The term «genome editing» encompasses a series of biotechnological processes that can trigger genetic changes with a relatively high precision at selected locations in the genome of plants (and of all other living creatures). The most famous method is called CRISPR-Cas. With this method only individual building blocks are removed from or added to the genetic material. Therefore, supporters demand an exemption from labeling obligation. The first rape seed (Cibus Rape) variety produced with a gene targeting method is already on the market in Canada. In Germany, the approval procedure was interrupted after major protests. This variety would be protected by a patent, but without labeling it could easily cross into other oil seed rape cultures. If other crop varieties are also modified with these methods, and allowed to be cultivated

without identification, problems will arise for many varieties from the ecological breeding sector. Genetic «pollution» would destroy ecologically bred varieties – this apart from problems with respect to possible patent infringement, which has become almost the rule with GM plants (see below).

4. Conclusion: The failure of politics – the biodiversity loss continues

National and international agricultural policies pay little attention to this situation. Despite substantial efforts to date, the numerous international treaties have been able to neither defuse the problem nor stop the loss of cultivated and variety diversity. The Biodiversity Convention (United Nations 1992) was adopted at a UNCED conference in Rio in 1992, and ratified by 30 countries in New York at the end of 1993. For the first time, the loss of biodiversity, including agrobiodiversity at a global scale, was on the political agenda. The importance of biodiversity for food security and food sovereignty has been emphasized in particular regarding climate change. However, a committing resolution was not enough. During the following years, the problem was discussed at other conferences. FAO (2009b) entered into a framework agreement with the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the Nagoya Protocol (CBD 2011) adopted for the first time binding guidelines in which the rights of the population in countries with a substantial biodiversity are protected. The treaty grants appropriate compensation to nations with a great diversity of species and varieties when those are used by organizations and seed companies in industrialized countries.

Not unexpectedly, these proposals were confronted at the time with justified criticism. In contrast to wild plants, where species clearly differ genetically from one another, this is not the case with agricultural crops. Firstly, the used varieties are often the result of intended or accidental crossings with other relatives. Secondly, one and the same cultivar can produce by adaptation in different regions quite different phenotypes, the relationship of which is no longer conspicuous. The effort required to identify genes of varieties genetically or to determine them as identical, i.e. to document their traceability, is enormous and is unlikely to be achieved (Begemann et al. 2012). The effort to delineate genes of varieties genetically or to determine them as identical, i.e. to document their traceability, is enormous and is unlikely to be achieved (Begemann et al. 2012). Breeders' associations in Europe (BDP 2014) and scientists in the USA (Cressey 2014) also fear that their research and development work will be hampered. For example, it is argued that the effort required is far too great, since a single gene sequence from a plant or a microorganism from a developing country would have to prove its origin. It requires substantial political will to consistently implement the Nagoya Proto-

The effort to delineate genes of varieties genetically or to determine them as identical, i.e. to document their traceability, is enormous and is unlikely to be achieved (Begemann et al. 2012).

col in its present form. It is doubtful whether, unlike with all previous treaties and regulations, implementing the Protocol can put an end to the eradication of the diversity of cultivated species and varieties. Also, regarding the question of compensation, which is discussed at a high level pursuant to the Nagoya Protocol, there is a need for greater transparency. Who are the real providers of conservation, use and development of the world heritage of biodiversity of our crops? The supranational view of the entire cultural heritage is in contrast to the breeders probing view that is dependent on the genetic resources for decisively solving pertinent breeding problems. If the breeder's solution is successful, an appropriate distribution of profits can and must be made to all involved providers. A flat-rate advanced compensation in an anonymous fund therefore always depends on a doubtful «whatever for». A general crop per mille (for further details, see below) on all plant products could provide the resources for non-profit projects in the conservation and development of crops.

5. Doubts about the success of international efforts

However, doubts are also fueled by economic agreements that governments in the developing countries themselves initiate, supported by the activities of companies that do not face opposition from the politicians in those countries. For example, with the free trade agreement between Canada, the USA and Mexico (NAFTA), the import of US corn to Mexico has been fully liberalized with serious consequences (Ackermann et al., 2003, Wise 2007). Prices for corn fell by 50 percent. The average income of the rural population decreased by 70 percent and the cultivation of traditional varieties decreased from 50 (1960) to 30 percent (2005) of arable land and from twelve to only three varieties.

The same history threatens to repeat itself in Africa. At the end of March 2015 during a meeting in Addis Ababa of the committee of COMESA (Common Market for Eastern and Southern Africa), which is a counterpart to other free trade agreements, with the participation of the Bill and Melinda Gates Foundation and the American development aid organization USAID, a master plan for the «harmonization of trade rules for seed» was agreed upon (Greenberg and Tickell 2015). Logic dictates that the seed market must be opened for international corporations in order to make the production of agricultural goods profitable in Africa. The plan aims to restrict or prohibit the diffusion and exchange of traditional land and farming varieties that farmers harvest every year on their fields.

It is bordering on irony that only a few weeks before Vanek and Zimmerer (Penn State 2015) have shown in a study that to this day, the diversity of crops worldwide has been cultivated, maintained and developed by farmers with less than two hectares of arable land. Although on those small hectarages seed is traditionally a common property, this form of sustainable use is threatened by international politics.

Subsistence agriculture is also affected by other developments. Young people have an basic need to break out of traditional ways of life in order to gain independence. Not least because of this, people the world over tend to migrate from the country to the cities. It is foreseeable that in the developing countries, the history of agricultural development as it took place in Europe, will repeat itself. As in our case, an increasingly smaller part of the population will in future work as farmers. The increase in yields and the mechanization of production will grow and with it also the demand for crops and varieties that fit the new production conditions. To the extent that the traditional preservation of biodiversity is abandoned, in the interest of the general public new and viable ways of conservation and development must take their place. ■

Spelt

B. Common property and common pool resource management

«Without the concept of common property, there would be no cities, no irrigation systems, and no seed.»
Weston and Bollier 2011

1. Origin and development of common property

From the viewpoint of the history of man and consciousness, «community» and «cooperation» cannot be separated from humanity.

In the original subsistence economies around the world, seed has always been regarded as the common property of nations or regional communities. The privatization or the right to breeders› protection is relatively new. It has been developed for the last 100 years in the industrialized countries during the increasing division of labor between breeders, seed propagators, farmers and gardeners. It is therefore worthwhile to take a look at the origins of common property or common pool resources and their user communities, which have been operating for a long time in a sustainable manner. This type of property rights is deeply rooted in the origins of modern humanity and emerged from them. From the point of view of human history and consciousness, «community» and «cooperation» cannot be separated from humanity. The basic human characteristics of walking, talking and thinking are not inherited, but must be acquired by the young child in the (family) community. Anthropology teaches that the early hunters and collectors could survive only in groups. Community building has intensified since the beginning of settling and the emergence of agriculture. Fields were jointly cultivated and harvested. Their protection from animals was taken care by everybody in turn. The nomadic pastoral tribes together organized their migration with their herds, their protection and their use. The abandonment of the idea of common property and its cooperative use took place for the first time only in the 20th century with the attempt to expose any cooperative and altruistic behaviors as hidden egoism – first in biology and later in sociobiology and psychology (Dawkins 1978, Wilson 1975).

Agrobiodiversity is a byproduct of sustainable agriculture

The drastic decline in agrobiodiversity – similar to the overuse or pollution of other natural resources – has resulted in the awareness that the large variety of crops from a global perspective is an asset worthy of protection. To protect this diversity as a human heritage is reflected in the contractual framework

of the Convention on Biological Diversity (CBD) and the International Seed Treaty of FAO. However, the acceptance and implementation of the protection is hampered by the ideas of the neoliberal market economy and its political anchoring. The threatening factors are of a social nature and have only an indirect effect on the intended good, but they are in fact severe as described above (Hurter 2013). Once we look at the source of this good itself, based on the created wealth of cultivated varieties and their preservation by communities, it is clear that these varieties, as well as those lost, also emerged due to links with human activities. As the study of Vanek and Zimmerer (Penn State University 2015) shows, the range of cultivated varieties is developed by the breeding activities of small farmers and is propagated and maintained under social traditions.

This good, which international treaties aim to protect, is the result of agricultural and social practices that are locally operated and transmitted without aspiring to directly increase the range of varieties. Therefore it is important to support and protect not only the agrobiodiversity as a stand-alone result, but also above all the agricultural practice which is unintentionally produced as a «by-product».

This is the conclusion of Elinor Ostrom, winner of the Nobel Prize for Economics in 2009. She researched the conditions and structures that guarantee the successful use of common goods and common pool resources and analyzed their long-term use by user communities (commoners) worldwide (Ostrom 1999). This analysis can serve as a tool for producers, breeders, states and farmer communities, which defines the social, political and economic framework conditions worldwide under which agrobiodiversity is sustained as a common property and will be further developed.

For seed, it is obvious that it will become a common property only in the hands of user communities, but this applies to all natural resources (Helfrich et al., 2009, Helfrich and Bollier 2016). Their use has always been based on trust and fairness, direct communication and personal acquaintance.

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2. Common property – Between states and markets

Common property has to face various challenges. It is the middle between profit-oriented private companies and their production goods – automotive, high-performance varieties and other goods – and governmental institutions with public goods – roads and railways that under the slogan of «liberalization of markets» are increasingly under pressure. The position of user communities in the middle – between market economy and the government, as Ostrom (1999) has described its socio-political situation – makes it economically and politically vulnerable.

The second challenge is the peculiarity of seed. When talking about varieties, the term «common property» must be extended from material to spiritual common property. In contrast to the past, it is self-evident that nowadays not only water and soil, but also ideas, sounds and musical intervals are commons. While the Greek philosophers were still talking about «daimon,» which provided them with both the universal thoughts and insights in spiritual contexts, nowadays we personally identify ourselves with the ideas we have produced. We see ourselves as their first creator, even if it has always been clear that every other person can think and express the same idea as well. It is a step out from the community of a conventional or traditional life or research area, a realm of thought and speech based on individual achievement. The identification of the person with his or her creative achievement is the basis for copyright as well as for the protection of varieties, and partly patents. However, the latter includes, with the concomitant claims, range and depth of invention. Thus, it combines the old Roman property concept of the «occupatio» with the modern concept of ownership or «ownership by achievement». Occupatio refers to the arbitrary seizure of an «unclaimed good» or the ousting of the previous owner.

When talking about varieties, the term «common property» must be extended from material to spiritual common property.

Ownership by achievement on the other hand, was created by John Locke (1632 – 1704). It is based on the assumption that a person deals with a natural property – as a rule a common property – or a raw material. The person therefore puts a part of himself into the object. This added value is his property and serves as the basis for the distribution of profits in a labor-sharing society. However, we should not forget, in the case of seed, the «raw material» is always an existing variety.

3. The design principles of user groups according to Elinor Ostrom

In countless examples, Elinor Ostrom and her co-workers have investigated how villages, fishermen, or communities, e.g. in case of a potable water supply, still use common pool resources sustainably. The oldest documented user community was mentioned for the first time a century ago, and still works to this day. It provides and manages among other things forest avalanche protection in Törbel (Valais, Switzerland). From insight and foresight, communities abandon the greatest possible appropriation (exploitation) of their resources and are also willing to invest labor and money in maintenance and security. Where does the success of sustainable use come from; when are common pool resources and their user communities judged to be failing? For both – success and failure – Ostrom found internal and external reasons. Internal reasons include lack of trust and insufficient reciprocity, weak regulation and monitoring of use, or unclear arrangements about who is entitled to use the resources in question. An external reason is the lack of acceptance on the part of the authorities.

Based on her extensive research, Ostrom has formulated eight «design principles» that have been applied to successful, sustainable use (Ostrom 1999, see https://en.wikipedia.org/wiki/Elinor_Ostrom):

1. Clear definition of the contents of the common pool resource and effective exclusion of external un-entitled parties.
2. The appropriation and provision of common resources that are adapted to local conditions.
3. Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process.
4. Effective monitoring by monitors who are part of or accountable to the appropriators.
5. A scale of graduated sanctions for resource appropriators who violate community rules.
6. Mechanisms of conflict resolution that are cheap and of easy access.
7. In the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local CPRs at the base level.
8. Self-determination of the community recognized by higher-level authorities.

The design principles of Ostrom touch on three levels: economic, legal and socio-cultural.

- Principles 1 and 2 determine the private rights and obligations, i.e. the economic value of the common pool resources with respect to usage and effort of expenditure as well as to restricting the number of users.
- Principles 3 to 7 organize the self-administration structures of the user community and therefore constitute the domestic law.
- Principle 8 serves the sustainable relationship of the community with its social and cultural environment as well as its recognition as an independent entity.

The differences between the practices of private owners and state enterprises are at first sight small. The big difference is that all important competences are in the self-administration of the user community. Therefore, there is no specification for the arrangements, no external control and no sanctions by institutions outside the community. Ultimately, the further development of the rules is in the hands of the user community when those rules have to be adjusted after conflicts or due to the change of external conditions.

IAD – The design instrument for user communities: As early as 1999, Ostrom formulated ideas regarding the relationships of user communities with the social and political framework and developed them further in 2007 under the headings of «Institutional Analysis and Development» (IAD) (Ostrom 2007, 2009). It is a tool to analyze the dynamic relationships between the resource›s user communities with their own rules, the authorities, the natural and political conditions, as well as the other stakeholders, and to derive actionable options.

It is assumed that common property and its user communities are part of a «socio-ecological system» in which the separation of social and ecological values is viewed as artificial and arbitrary.

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Figure 2:
The IAD for seed and its users

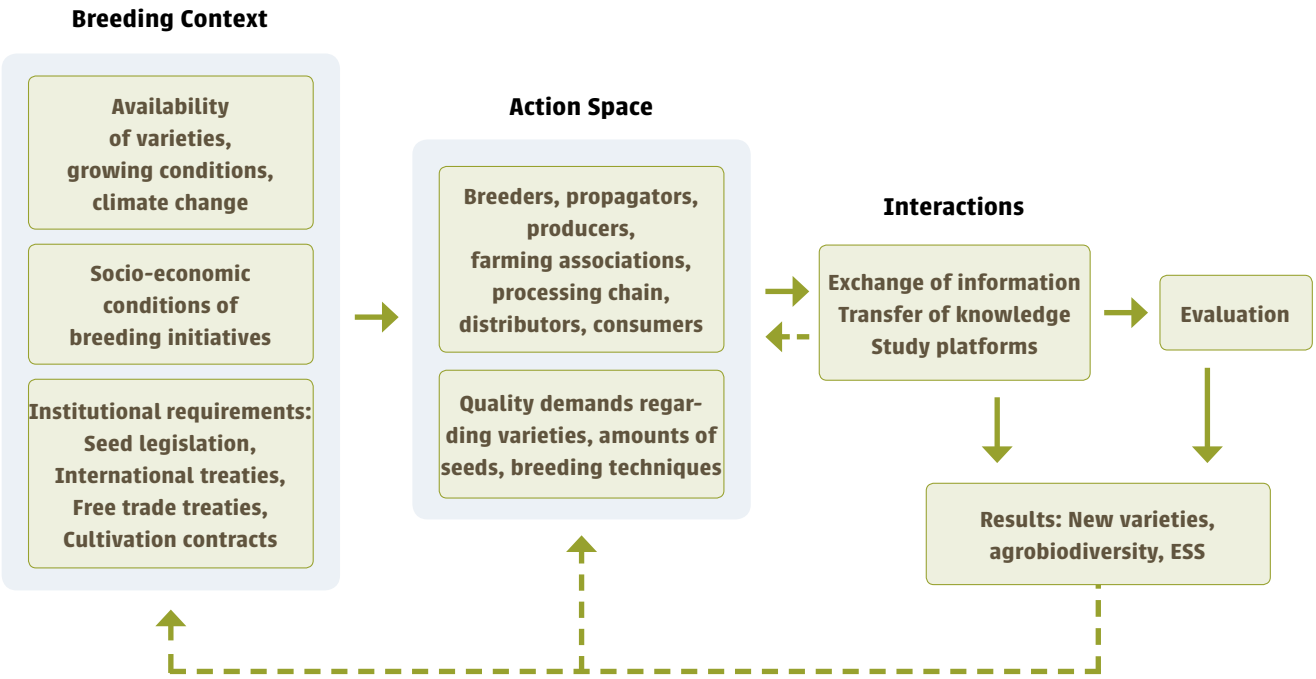

Fig. 2 shows a diagram of how the IAD for seed and breeding initiatives could be structured to investigate developments, challenges and future scenarios (based on the presentation of Ostrom 2009).

The «breeding context» determines the natural conditions under which breeding takes place. It also includes a description of the specific social and economic conditions under which the breeders work and also the political, legal and legislative requirements which must be taken into account.

In the «action space», all users and the requirements which they expect from cultures and varieties are addressed. The structure of the interactions suggests how users, together with officials and political representatives, can set development goals for breeding, evaluate successes, but also overcome challenges and problems – with an open, transparent and constructive exchange. The results of the breeding efforts are high-quality varieties for producers, processors and consumers, as well as contributions to the improvement of agrobiodiversity and ecosystem services. An evaluation of all parts of the entire process is carried out on a regular basis.

With the IAD, processes between the users of the varieties and the legal and political conditions can be adequately depicted, and future scenarios can be simulated taking into account changes in internal and external conditions. Here are just a few examples: as we shall see, the patenting of varieties, be it vegetable or other crops, has a major impact on the breeding work. On the one hand, such varieties can neither be reproduced nor used by other breeders for their variety development. On the other hand, cultivation can lead to cross-breeding between patented and non-patented varieties, as has already been the case with genetically modified crops (see below). It is also possible that changes of variety protection legislation on national and international level will result in the loss of registration, for example, when requirements for distinctness, uniformity and stability are tightened. However, changes may also entail restrictions on the rights of farmers and breeders.

The arrows connecting the different areas in Fig. 2 are an indication of the complexity of the entire process. As is often the case in complex systems, feedback mechanisms are frequent and render it impossible to make precise predictions about the impact of changes (be it conditions of use, climate change, legislation or political requirements). «Feedback loops» with minor changes can have a great impact on the overall system – similar to a double pendulum or the «Butterfly Effect». Therefore, Ostrom warns about expectations of a panacea in the sustainable use of common property. She emphasizes that changes and improvements of use must be accompanied by small steps in increasing experience of use and the willingness of all stakeholders to correct mistakes.

4. Seed and its user communities in organic plant breeding

For many millennia, seed was a self-evident common property, which was locally grown, developed and exchanged. There was no separation between production and breeding. Village communities and geographical boundaries – a self-evident fact until the beginnings of the twentieth century in Europe as well as today in many parts of the developing world – resulted in a wide range of adapted varieties. This situation changed only when the production of vegetables and crops was intensified – the improvement of the cultivation of the land preceded the cultivation of the varieties – and the traditional landscapes could no longer cope with more fertile soils, quality characteristics and yield. As a consequence, division of labor and professionalization of breeding of new varieties began. A breeding practice detached from the cultivation practice emerged.

The history of this development is now reflected again in organic seed breeding. Varieties are produced with different breeding methods, for different purposes, different production methods and with different intensity of production – the user communities differ accordingly.

1. **Conservation breeding** focuses on preserving the uniformity of traditional or population varieties. Off-types are removed. Thus, this is negative selection. This strategy is being pursued by organizations that save old varieties: Pro Specie Rara in Switzerland and Germany, VEN in Germany, Arche Noah in Austria, Kokopelli in France.

2. In **selection breeding,** breeders basically start with the same plant material as the conservation maintenance breeders. But now conspicuous types are selected and propagated according to specific criteria. In a multi-year breeding process, a population with the desired traits is purified into a uniform population. An example is the work at the Keyserlingk Institute: cultivars from varieties are selected to cope with the local soil conditions and to meet the criteria for modern bread making with respect to baking quality.

3. In **crossbreeding,** new plant types are created. Starting from existing varieties, own breeding lines or other resources, plants with desired characteristics are crossed with one another. They are combined in individual plants via single or multiple crosses and are selected in the next generations in multi-step processes and with the aid of complex quality analysis methods. At the end of the process, a new, uniform and adaptable variety is the result. It can be registered and protected if it complies with the DUS criteria (distinctness, uniformity, stability). This strategy is being pursued for the crop production by a number of organizations developing varieties with very high quality and yield expectations: GZPK, FZ Dottenfelderhof, GZF Darzau, Kultursaat e.V., Reinsaat and Sativa-Rheinau.

The **breeding intensity** increases from conservation breeding via selection breeding to crossbreeding, and the respective user groups are organized differently (Fig. 3). The x-axis depicts the breeding initiatives, on the y-axis the breeding intensity is shown. The transitions between levels of intensity are fluid; breeding initiatives and organizations will, depending on the problem, use different techniques and can easily resort to the varieties of their colleagues. The two axes have two clear limitations. One limitation is breeding techniques; IFOAM (2014) has created a blacklist for organic farming because the techniques listed are applied on the cell and genome levels (including GMOs).

These techniques disregard natural plant propagation barriers and circumvent the limitations of natural hybridization. From this point of view, they violate the «integrity of the plants» as it is characterized e.g. in Switzerland (Rheinauer Thesen 2011) and incorporated in the Swiss federal constitution.

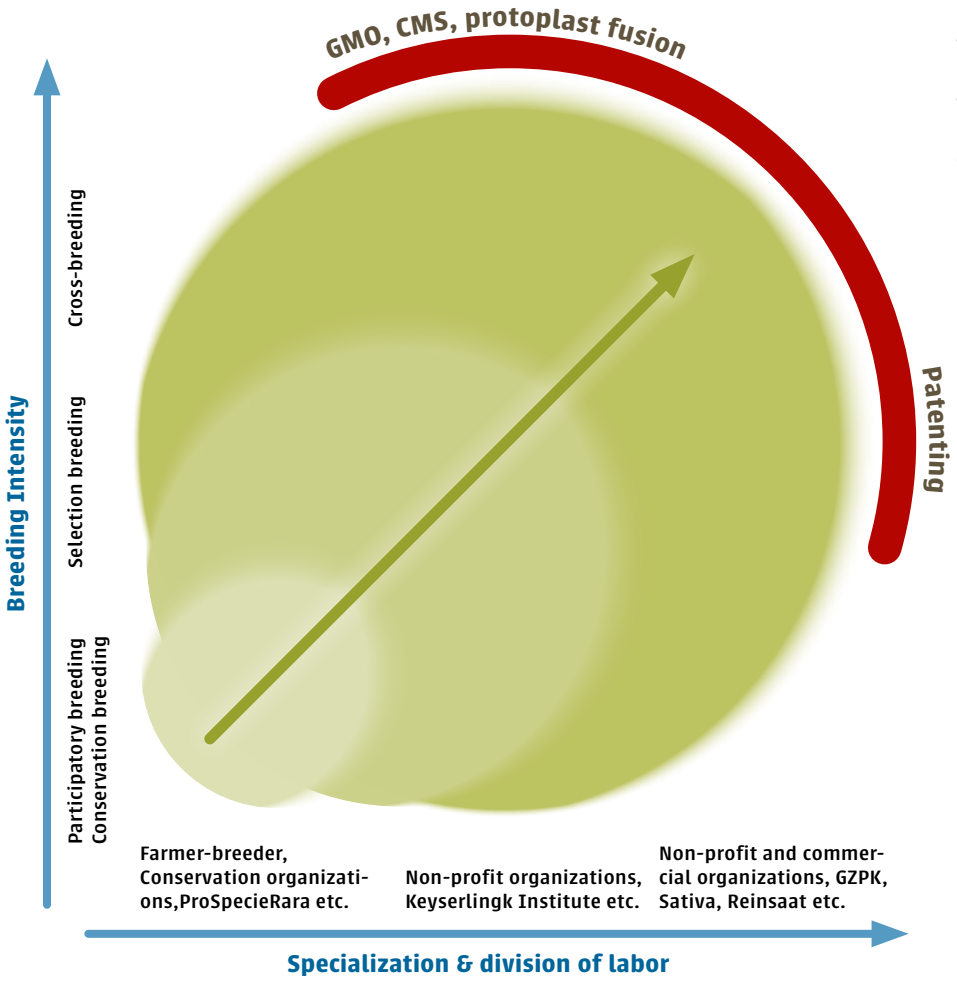

Figure 3:
The relationships of breeding intensity and breeding organizations; The red curve indicates inviolable limitations, both in terms of breeding techniques and property rights.

The second limitation concerns the patenting of seed. This mode of variety protection is a taboo in organic plant breeding. As we shall see, conflicts may arise around these limitations.

A user community is manageably small if it consists only of the members of a non-profit organization. By including the propagation organizations, the producers, processors, traders and retailers, the community becomes large, quickly reaching its limits in the joint design of strategic objectives and operational orientations. The ecological breeding initiatives are handling this challenge in a creative and situational way, and have developed creative approaches in the past. Being project-related and temporary, the organizations therefore allow the group of stakeholders to grow and shrink.

The four design principles of Elinor Ostrom (collective decisions, control, sanctions, and conflict resolution) form the core or the heart of a user community.

Conservation breeding organizations and seed sharing initiatives: In some conservation breeding organizations, varieties are propagated, and if necessary selected voluntarily by members of the associations. Customers contribute with a donation towards the expenses of the organizations. The user community includes all members of the association, but may also include the customers of their seed. Registration and protection of varieties play a minor role.

In the breeding of seed for commercial production, the variety of species and varieties is limited because of intensive and costly research and development. The availability of certified seed or elite seed developed by non-profit or non-profit organizations depends on three factors: firstly, the success of breeding and the approval of new varieties; secondly, the efficiency of propagation through contracts or multiplication for producers; and thirdly, the demand by processing companies and dealers through clever marketing.

The four design principles of Elinor Ostrom – collective choice decisions, monitoring, sanctions, and conflict resolution – form the core or the heart of a user community. They specify goals and methods and allow the exclusion of members. In larger associations, e.g. Kultursaat e.V., there are discussions about the focus or the use of certain breeding and evaluation methods. Often, the quality and agronomic characteristics of the partners in processing and trade are discussed and the corresponding objectives agreed upon.

External usage, protection and admission rules: For the registration and the protection of varieties, the requirements for production and quality, as well as the rules of use, are stipulated «from outside» and are recognized by a higher authority, for example, through the German Seed Marketing Act. This allows the rules to be enforced.

Non-registerable varieties do not have a binding legal status. An organization can set its own usage agreements, i.e. «inside» rules. This could be the case for a growing number of varieties if the European conditions of registration were to be tightened. In informal exchanges and seed markets, non-registerable varieties could still be handed over. In such situations the recognition of the user communities allows scope for self-determination and self-design.

Plant breeders sowing in autumn

Aristate wheat variety POESIE (POETRY)

C. Non-profit breeding in Europe

1. Biological-dynamic breeding initiatives

Rudolf Steiner made his initial suggestions for biodynamic plant breeding soon after WWI. His answer to the questions of Ernst Stegemann, one of the co-initiators of Steiner's «agricultural course», was that all crops would have to be bred anew in order to counter the loss of quality. During the following economic crisis and world war years, breeding initiatives at that time practically disappeared. It was not until the 1980s that new initiatives emerged which concentrated on breeding varieties of grain and vegetables. Due to the very low level of funding, the pioneers organized as a non-profit had only limited possibilities for establishing breeding companies, despite their great commitment. That is the reason why in 1995, the Future Foundation for Agriculture from GLS-Treuhand Bochum initiated the Seed Fund to support biodynamic breeding initiatives. At the same time, public relations for pressing issues was intensified. Fifteen years later, this fund was able to promote biodynamic breeding with more than a million euros annually. In 2001, the «Association of Biodynamic Plant Breeders» (ABDP) in Bad Vilbel (DE) with its own research institute and the «European Consortium for Organic Plant Breeding» (ECO-PB) in Driebergen (NL) were founded.

In 2010, Bio Suisse was the first organic association to make ecological plant breeding a core task and to promote it financially. In 2012, Bio Suisse together with the European organic associations and FiBL (Research Institute for Organic Agriculture), defined the most important principles of organic breeding and anchored them in the IFOAM (International Federation of Organic Agriculture Movement) guidelines.

These are:
1. Reproducible varieties, i.e. fully fertile
2. Breeding is carried out under recognized ecological conditions
3. Respecting the cell and genome as a unit (no technical interventions, no GMOs)
4. Respecting natural crossing barriers

The biodynamic breeders are also required to manage the rights of varieties in a non-profit organization. This excludes the privatization of profits.

Incorporating and training the breeder's view: «Success recipes» for biodynamic breeding

To date, more than 50 new varieties of cereal cultivars, well over 100 vegetable cultivars and the first apple varieties have been made available for cultivation across Europe. Nevertheless, none of the initiatives that have been recognized by the state as non-profit organizations are self-sustaining. Most of the capital comes from private donations, foundations and interested companies. Public funding for this work is very limited (see below). A central element of biodynamic breeding is its embeddedness in healthy biological-dynamic agricultural organisms. Animal husbandry based on roughage or on farm produced feed acts as a supplier of manure for sustainable soil fertility, and is in balance with production of field vegetables and crops. In addition, biological dynamic preparations produced on the farm itself support and individualize the organism. A supply of nutrients from the outside is provided only for the remediation of land with soil deficiencies. This embeddedness allows for a consistent holistic-integrated approach of breeding, since genetic and epigenetic effects as well as environmental properties remain closely linked. Additional elements are both the training of the breeder›s view, i.e. his or her awareness of the subtle effective connections, and the test methods selected for the determination of the adaptability of the plants.

In this way, resources can be used that must in principle be out of the scope of breeding activities detached from the specific farm setting. For example, there are regions in Italy, where animal husbandry disappeared from the countryside 40 to 50 years ago. Today the hilly fields are farmed with heavy machinery. All over the world, including on organic farms without cattle and even on dry grassland farms, soil erosion is an enormous problem. In most cases, the soil has been completely washed away from the upper third of the fields, while the remaining soil not yet carried to the sea is accumulating in the lowest part. The upper third does not yield and is cultivated only to access subsidies. In the same region there are organic farms that have retained traditional animal husbandry and thus crop rotation. There is a large range of biodiversity on these farms. Their yields are quantitatively and qualitatively much more stable, and the erosion problem is kept within narrow limits thanks to organic fertilization and considerably better soil structure. Integrated in this situation, biodynamic plant cultivation can develop varieties with significantly improved overall ecosystem services, an effect that is particularly strong at suboptimal sites with scarce water supplies, as is often the case in southern countries.

2. Ecological Seed Industry

While biodynamic cultivation is slow but steadily growing, despite chronic underfunding (Wilbois and Messmer 2016) and extremely long production cycles (12 – 15 years), a whole new ecological seed industry has emerged during the last 10 years due to rapidly growing demand. The most important seed companies, Sativa Rheinau AG, Bingenheimer Saatgut AG and Reinsaat, serve horticulturists and farmers as well as seed resellers and amateur gardeners worldwide. Together, they generate revenues of over 12 million euros. The growth rates are often double-digit, not least because the mere ecological seed propagation generally takes only one to two vegetation cycles. Even if these companies are registered as public limited companies, they are committed to common good and common property seed. Profits are transferred to ecological breeding and not to private investors.

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Since 2004, organicXseed (www.organicxseed.com) has been the official database for organic seed and plant material. It is an important Europe-wide instrument for transparency and implementation of the guidelines of European, national and organic producers' organizations (some countries have built up their own databases). These organizations prescribe the use of seed from ecological propagation as long as it is available on the market, that is, as long as an official database has an offer for a particular or comparable variety. Only when no suitable seed and planting material is available, farmers and gardeners are allowed to get an exemption for the use of conventional seed and plant material. The database, which is set up and supervised by FiBL (Research Institute for Organic Agriculture), allows the breeders and the seed trade, as well as the supervising authorities, to keep themselves up to date on the market situation in Europe.

The bioverita label (www.bioverita.ch), which aims to label transparently varieties and seeds from ecological breeding at the points of sale, is also worth mentioning. For the most part, it is not clear to seed buyers or consumers whether the seed is a biologically bred variety or whether such varieties have been used and processed in the product. Here bioverita aims to provide a remedy.

3. Necessary growth is a major challenge

Biodynamic and ecological breeding cannot keep up with the strong growth in the demand for ecological seed. Most cultivated varieties still originate from conventional breeding (Messmer 2014), since the use of varieties from ecological breeding can be bypassed relatively easily with exemption permits, despite the above-mentioned directives (Döring et al. 2012). Furthermore, the current variety offer in case of many plant species is still too small (Wilbois

and Messmer 2016). This practice is questionable, since many traders and consumers believe that organic farming products are grown with varieties from ecological breeding. The challenges to replace them in the short – or medium-term with varieties from ecological breeding are very high. There are a number of reasons for this, such as the small number and small size of the breeding initiatives, the breeding objectives, the policy of organizations, and above all the financing problems that are discussed below. In addition, breeding of locally adapted and reproducible varieties for ecological production is hindered passively and actively.

The developmental potential of ecological breeding is affected by many factors. The first are the breeders themselves, who have begun breeding seed and varieties for ecological farming in a time when practically no demand existed. Their visions and goals were individually shaped, as was the selection of cultivars and varieties. Familiar with the knowledge of conventional practical breeding, they first had to learn how to deal with the specific requirements of low-input production and to look for varieties which could meet the specific production conditions of organic farming from germination to maturity.

With the exception of the biodynamic movement, the organic producers› associations initially showed little interest in ecological breeding. The situation changed only with the intensification of conventional breeding, which made access, reproduction and further use of the varieties more difficult because of hybrid seed, CMS, GMO and patenting. It was taken up by some national associations which resulted, for example, in financial support for breeding initiatives in Switzerland. A boost was initiated 10-15 years ago with the introduction of the first wheat varieties from biodynamic breeding, which were clearly superior in quality to conventional ones and which have long since become the standard. This boost has not yet reached all producers and has not been the case for all crops.

Again and again, for many varieties, derogations are made in order to continue using seed from conventional breeding. Beside the fact that cultivars and seeds from ecological cultivation are not available for all crops, attempts are made to obtain exemptions for economic reasons, since conventional seeds are cheaper to buy than those that are ecologically bred. This practice is bad for breeding work (Fig. 4), since the total licensing income – a multiple of the total current costs for non-profit ecological breeding! – goes each year into the coffers of conventional breeding companies. As Döring et al. (2012) demonstrated, derogations have several negative impacts. The lack of demand for ecologically bred seed reduces the revenues of the breeding initiatives and thus the expansion of the range of varieties. There is no money for stimulating development.

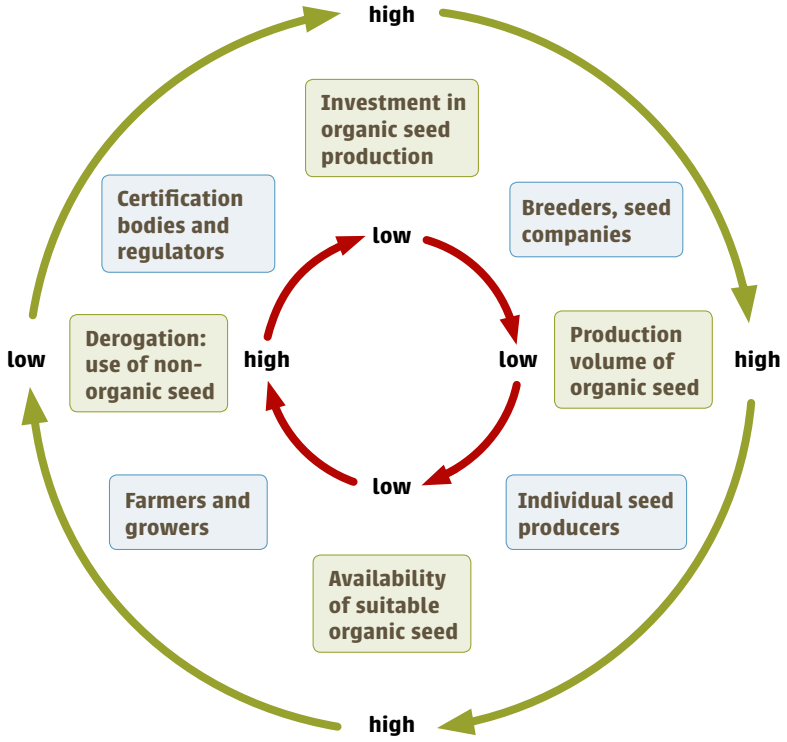

Figure 4:
The effects of increased (red arrows) and reduced derogation (green arrows) on breeding and seed trading (Döring et al. 2012).

The demand to use seed for ecological agriculture only from ecological propagation and breeding, can therefore be welcomed. As mentioned above, it promotes authenticity and transparency for consumers. At the same time, however, the demand leads to the bizarre situation that international seed companies are suddenly showing an interest (Conference Brussels 2016) in serving this part of the seed sector. The argument that these companies' seeds can also be selected on organic farms with their breeding programs may be true in certain cases, but the companies lack the knowledge for an integral assessment of the entire developmental process of the crops. Even more disturbing is the prospect that varieties for ecological agriculture could soon be developed with the biotechnological methods of «genome editing». Therefore the authorities should not refrain from requiring labeling of such varieties.

4. Variety protection: Open access and protection at the same time

Protection of varieties was developed in the last century in Central Europe and supported by the UPOV (Union internationale pour la Protection des Obtentions Végétales – International Association for the Protection of Plant Varieties), which has been joined by more than 80 countries worldwide. It grants protection to a variety which has been demonstrated to be new, stable and sufficiently homogeneous, for a maximum of 20 years; i.e. for a limited period of ownership. The protection extends only to the seed production, which ensures the breeder a license revenue for the breeding of future varieties. At

the same time, the principle of open access applies, which makes the breeding progress publicly accessible. Protected varieties may be used by anyone for further breeding according to the «breeder's privilege» a regulation with considerable scope and size. Anyone can declare himself to be a breeder and actively participate in the development of crop diversity itself. Without asking for permission, he can access the genetics of the latest varieties and continue to work with them. This ongoing worldwide and free exchange of the latest and best genetic resources between the competing (!) breeders is a central source of plant breeding, regardless of whether the breeding is conventional or ecological.

A second privilege that is not less important for farmers: the right of self-sufficiency and food sovereignty, including the right to produce seed for the own usage.

A second privilege that is not less important for farmers is the right of self-sufficiency and food sovereignty, allowing for propagation of seed for their own use. An unresolved issue is reproduction. While the protection of variety secures the breeders a propagation license of the produced seed, farmers are able to produce their own seed for the production of marketable goods, at least for easily reproducible cultivars such as cereals, beans, peas and lupines. This denies the breeders, including biodynamic breeders, important income that they need to continue their work.

From the perspective of the previous view, the UPOV system of protecting varieties is a complicated system of rules and rights but is in agreement with design principles identified by Ostrom and the IAD. Thus, it is a policy tool for a common property. It defines what can be protected, has access rules, describes exceptions and sets rules for dealing with violations. Finally, the whole legal system, which mediates between individual private and public as well as socio-cultural interests, is recognized by the higher authority, the Contracting States, as well as by the EU.

5. Stricter rules and truncated privileges

However, with the revision of the UPOV Treaty (UPOV 2005), additional obstacles are created for organic breeding. It aims to reduce the rights of small breeders and producers. For some crops, the duration of protection of the variety has been increased. In addition, the claims regarding the characteristics of the varieties (DUS criteria homogeneity and distinctness) were tightened and the privilege of the farmers reduced – harvested materials can strictly be used only for reproduction on their own farms. These developments make breeding initiatives in ecological farming difficult and will also increase the dependency of farmers on large seed companies. he UPOV revision is often criticized by developmental and seed exchange organizations (Lieberherr and Meienberg 2014). Protected varieties may not be propagated and disseminated without a contract with the breeder. Where protected and traditional varieties are used in the same area, misunderstandings and ab-

uses can happen in both directions. It is not uncommon for countries to be obliged by bilateral agreements to introduce the UPOV rules as the only system which makes traditional varieties illegal and secures exclusive market access for the seed companies. In many places there is no awareness and no best practice for enabling the division of labor between breeders, seed propagators and seed users, as has been developed in Europe over the past 100 years, to make a corresponding fair financial compensation. Conversely, where the seed exchange in the developing countries is necessary for survival in a completely informal system, there is also no expectation for adapting the protection of varieties according to the European model.

For years, Switzerland has shown how coexistence between UPOV varieties and niche varieties with a very low-threshold for registration, can be achieved without any problems. Since 2010, farmers have been able to cultivate so-called niche varieties, thus providing consumers with a more diverse range of e.g. old potato varieties. The regulation in the seed and seedling legal ordinance promotes the diversity of crops. Switzerland therefore has a seed and seedling law that, in addition to its actual goal of ensuring the safe supply of food to the population, also explicitly contributes to the conservation and promotion of biodiversity in crops (BLW 2010).

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In 2013, the EU Commission presented a revision of the seed regulation, which was however rejected two years later by the EU Parliament (EU 2015). It would have entailed a major negative impact on the breeding and propagation work of small seed organizations, giving a foretaste of the regulatory orientation, which, as feared, will sooner or later be resumed. This would mean that in future only high-performance or elite varieties would be worthy of protection. Amateur and conservation varieties could still be registered, but would have lost protection. Their seed production would be limited and the cultivation would be severely restricted. Such varieties are used by amateur gardeners and also by professional producers. Old cultivars and private selections offered on non-commercial seed markets and exchanges would have lost both registration and protection. In addition, organizations that conserve or develop such «niche» varieties could be forced to limit the number of employees to a maximum of ten and their turnover to two million euros. After the rejection of the proposal, a «resolution» of the European Parliament from 2014 got more weight. A long list of claims to the EU Council of Ministers calls for the protection and preservation of old varieties, and emphasizes the need for regional varieties. It calls for the long-term financial support for breeding initiatives that deal with such varieties from public authorities. In most European countries there are government organizations that document the national varieties of arable, vegetable, fruit and berry cultures, ensure the storage of varieties in gene banks and build databases. However, until today, none or only very modest amounts of government funding are reserved for the development of new varieties in ecological breeding.

A rough outline of the situation in the seed sector shows the following picture. On the one hand, large companies want to protect and market worldwide their varieties, which often arise from hybrid cultivation, and as far as possible do so with exclusive property rights. An authority is making concessions to them with increasingly stricter requirements for seed. As a result, varieties which do not comply with these requirements, are losing their marketability and are at risk of being lost in the long term. On the other hand, there are the ecological breeding and conservation organizations that are mostly organized as non-profits. Their varieties, as far as they can be put on the market at all, are transferred to third parties as common property without any restrictions. The conservation organisations value diversity and further develop genetic diversity for regional needs. For such varieties, there is no large-scale demand. Due to the relatively low amounts of seed, they will never be as profitable as those of the conventional seed companies.

6. The charitable character of ecological breeding

With the consistent focus on sustainable, resource-limited agriculture, varieties from ecological breeding also bring substantial improvements to ecosystem services.

Ecological breeding contributes to the creation of common value in various ways. Firstly, as with conventional breeding it increases, but to a much greater extent, the conservation and regeneration of biodiversity in situ, i.e. in the fields. Each new reproducible variety makes such a contribution. By consistently focusing on sustainable, resource-restricted agriculture, varieties from ecological breeding also enable significant improvements in ecosystem services, such as improved nitrogen efficiency (since synthetic fertilizers are prohibited in organic cultivation) and allow for resource-saving production (since the use of chemical pesticides is not permitted). In order to achieve these goals, organic breeders maintain their own pools of genetic resources, which differ greatly from those of conventional breeders. Frequently varieties that prove themselves in organic farming are quite different from those used in conventional production. Of each processed type, a biodynamic breeder maintains and cultivates hundreds of thousands of plants every year in his breeding nursery, often involving thousands or even tens of thousands of plant lines which are constantly being evaluated and slowly and steadily developed through repeated selection.

Out of a hundred crossings, just one might make it onto the market as a new, commercially successful variety. All other crossings serve as «pre-breeding», for the buildup and permanent availability of a broad, vibrant diversity for the future. This diversity was in cultivation in the past, in the times of subsistence economy, and, wherever it still remains today, is in cultivation every year in the fields of farmers and in vegetable gardens.

Nowadays, as this diversity is disappearing from the fields of farmers or has already done so, breeders maintain it in their nurseries. In view of the ever more accelerated climate change, diversity is of great importance for the further development of crops. As gene pools, breeding nurseries are at least as important as the conservation of the germ plasm in gene banks, since in the latter they are excluded from any kind of adaptive evolution. The basically reproducible varieties of ecological breeders are an openly available gene pool, a common property that can be constantly increased in value by regular use.

This contrasts with the hybrid varieties of conventional breeding companies, which, with the exception of CMS hybrids, can still be reproduced. However, because of the unavoidable genetic segregation, in the next generation hybrids lose their uniformity and thus their valuable agronomic properties.

Practical breeding requires a great deal of knowledge and a wide range of experience, which is also a common good that is passed on through internships, training, further education, consultancy and knowledge transfer. All organic breeders organize courses, conferences and public events that meet with a great response and interest.

«Profits» remain the property of the ecological breeding community! In contrast to profitable seed companies, there are no shareholders who receive through cash dividends a large income regardless of their performance. This is to use an expression of Wolfgang Hoeschele (2010), part of the «economics of abundance», which according to the author is in contrast to an economy of scarcity of goods and money. It is obvious that it is not the goal of the farmers to maximize profit but to focus on common goods such as the sustainability of production, the far-reaching self-determination of producers and the health of consumers. With the explicit common use of non-profit legal formats, the initiatives give themselves by-laws and statutes that, in the interest of the general public, regulate fundamental objectives as well as rights and obligations of membership. Therefore their work is recognized by external authorities. In this sense, they are according to Ostrom user communities, which have existed successfully for decades and continue to evolve. In addition, they are interlinked (see Messmer 2014) and have open contact with authorities, government agencies and the national and international organizations of organic and biodynamic agriculture. The results of the various breeders› organizations are substantial, in terms of both the number of traditional vegetable or cereal varieties and the number of new breeds, especially since they were developed with few employees and very modest budgets. To develop a new variety, they often require only part of the estimated costs of conventional breeders. Government research institutes estimate the effort at around 300,000 – 900,000 euros, depending on the type of plant, marketing system and intended use (BLW 2015).

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The results of the various breeders› organizations are substantial; both in terms of the number of traditional vegetable and cereal varieties as well as the number of new breeds.

The financing of ecological breeding is supported by many actors (Kotschi and Wirz 2015):

- Contributions and donations from members and friends of the non-profit associations
- Contributions from foundations for basic funding
- Funds from foundations, governmental organizations and the EU for specific projects
- Cooperations with and service orders from processing companies and traders
- Licensing fees and variety development contributions from the sale of seed
- Subsidies and service contracts from organic farming organizations (in Switzerland, for example, Bio Suisse)

7. Breeding as a source of culture, real economy and law

The activities of ecological breeding have an impact on three different aspects of society (Fig. 5). One is **culture**, which derives from the creativity of the people and breeding organizations – it belongs to the realm of spiritual life such as science, fine arts, literature or theatre and music. Here, seed, or more precisely the spectrum of varieties, is part of a cultural property, i.e. biodiversity. In this respect, it does not have an attached price, but an infinitely high value! If one were to enquire about the users of this sphere, it would apply not only to people currently alive, but also to all future humans. Seed is a cultural property that has been cultivated and further developed in the community of peoples for ten thousand years since the beginning of agriculture. In place of the «old» subsistence communities, more and more individual breeder personalities, breeder organizations and companies are taking their place.

Seed is always also part of the real economy, i.e. a market or trade commodity. It is a means of production in the real economy, even if it is exchanged for free. Here, prices depend on supply and demand and other influences, for example on the variety «embedded» in the seed. As with other cultural institutions, the non-profit breeding work is part of real economic life. Like them, it is dependent on the support of the public domain to fulfill its cultural mission. But in view of the wide range of additional effects which benefit the public, albeit hardly acknowledged in politics and not compensated for through the seed price, non-profit breeding is just as worthy of support as other cultural institutions.

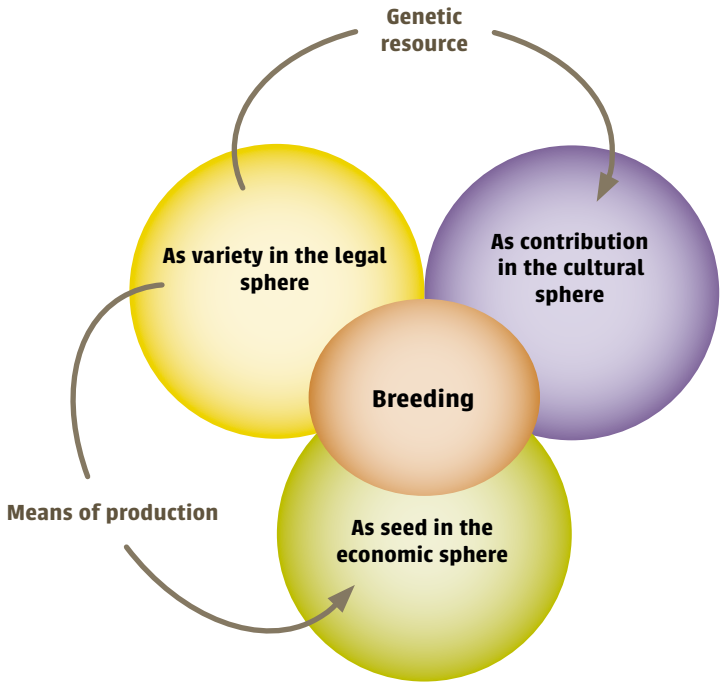

Figure 5:
The varieties of biodynamic cultivation belong to cultural life as a cultural property; as a common property in a legal sense, or as a commodity in the economy.

The legal sphere includes everything that has to do with «variety». It is not a commodity, but a right that can be transformed into a means of production by seed propagation. The variety has only real economic value as a seed.
At the same time, the variety belongs as a genetic resource (which is also not a commodity!) to the cultural property, which can be transformed by skilled treatment by the same breeder or by another one into a new variety.

The breeder therefore always reverts to existing cultural goods in order to produce a new legal good, a new variety which as such will turn into only a real economic good by propagation of its seed.
What exactly is meant by «variety» as a legal right is the subject of agreements, for example in the UPOV Convention and in national seed laws. With the criteria of distinctness, uniformity and stability as a standard rule, it applies not only to the official approvals of varieties and protection tests, but also to the increased propagation of seed and trade in it. If one offers to trade the seed outside these standards, then one must come to an agreement with the recipient or the public as to what is considered to be a variety. Warranty issues apply to such seed when it is offered for commercial cultivation.

8. Handling property rights

The variety of non-profit breeding initiatives is also reflected in the handling of the property rights of their varieties.

Biodynamic initiatives

The **GZPK** (Getreidezüchtung Peter Kunz, www.gzpk.ch) has until now developed a dozen wheat and six spelt varieties for professional cultivation (Fig. 6). For these varieties, it has obtained the registration necessary for marketing as well as the mandatory variety protection. The owner of the variety is the breeder in person, in order to make visible his share of it and input to its creation. The selection of a variety from thousands of plants is a process of recognition, a new formation, an act of creation. The propagation and marketing of the varieties is carried out according to regional requirements in specialized companies throughout Europe. The user right of the varieties is executed by the non-profit association or the non-profit foundation. This legal format ensures that the profits from marketing of the varieties flow back into the activities of the association. In parallel, triticale, emmer wheat and corn, as well as varieties for specific uses, are used specifically for Swiss niche varieties.

Figure 6:
Field inspection in the breeding nursery of GZPK in Feldbach

In Germany, the **research and breeding nursery Dottenfelderhof** (www.dottenfelderhof.de/forschung-zuechtung/aktuelles.html) develops cereal varieties for organic cultivation (Fig. 7). To date, five varieties, one conservation and two population varieties have been approved by the Federal Center for Plant Varieties (BSA). Approvals were also obtained for a winter rye variety, a feed corn variety and two feed corn populations. Further varieties of winter and summer wheat, winter and summer oats, respectively, are registered with the BSA and under examination.

Figure 7:
Aerial view of the breeding nursery at Dottenfelderhof

At **Getreidezüchtungsforschung (cereal breeding research) Darzau** (www.darzau.de) a whole range of grains were processed (Fig 8) including wheat, rye, barley, oats and mixed cultures, as well as a protein plant, the pea variety Nichkes. Some varieties have BSA approvals, while others – traditional varieties with particular properties for consumers – are protected by the Patent and Trademark Protection Office.

Figure 8:
The harvest team in Darzau

Kultursaat e.V., an umbrella organization of some 40 breeders who are engaged in the cultivation of vegetables (Fig. 9). It has registered more than 60 varieties and 13 conservation varieties at the German Federal Agency for Plant Varieties (BSA), but in referring to seed as a human heritage, it deliberately forfeited protection (www.kultursaat.de), since this is not compulsory for vegetable species.

From the biodynamic seed initiatives, three important trade organizations have emerged, which initially sold the newly developed varieties, but soon also propagated a number of varieties, or looked for partners, farmers and gardeners who commissioned the propagation.

Figure 9:
View of a breeding nursery of a breeder of Kultursaat e.V.
(Image: Marek Thielemann)

The oldest organization is **Sativa Rheinau** (www.sativa-rheinau.ch). More than 40 years ago, Ilmar Randuja started his pioneering work at Ekkharthof in eastern Switzerland with the conviction that biodynamic agriculture depends on biodynamic seed. He started the initiative long before the genetic engineering era and at a time when organic cultivation was hardly noticed by the general public. In 1999, Sativa AG was founded and has grown into an organization which currently distributes around 500 different varieties for professional vegetable and crop production and is also engaged in the breeding of vegetable varieties (Fig. 10).

As a successful economic enterprise, the organization is still committed to its original vision, and subsidizes a large part of the breeding work from the returns of the business enterprise.

Figure 10:
View of a greenhouse of Sativa Rheinau: Elite plant varieties of carrot, broccoli and fennel are protected from accidental insect pollination.

In 1998 in Austria, an initiative was also launched by biodynamic and organic manufacturers, which nowadays cultivates and trades vegetable seeds under the name **ReinSaat** (pure seed). As with Sativa, there are several hundred open pollinating varieties which include a whole range from their own breeding work.

Bingenheimer Saatgut AG is also the result of an engaged group of biodynamic gardeners. Nowadays it is an organization for propagation and distribution of varieties of approximately 80 biodynamic businesses, which are included in Kultursaat e.V.

All three organizations work according to the following guidelines: all varieties which are distributed by them have to be able to reproduce. They are common property which can be maintained only by user communities. The development, propagation and sale of seed require structures that harmonize with the goals and claims of their varieties in the social and societal context.

While the above mentioned breeding and distribution organizations are breeding and selling varieties for professional production, and breeding the properties necessary for it, the breeders in the **Keyserlingk Institute** (Fig. 11) are developing old local cultivars and old varieties. Unlike modern varieties, they do not enjoy registration or protection, but are grown by farmers and professionally processed by millers and bakers in the region (www.saatgut-forschung.de). A few individual varieties are registered as conservation varieties.

Figure 11: View of a field with the variety Alauda, which was bred at the Keyserlingk Institute, Brachenreuthe

Conservation initiatives

At ProSpecieRara (www.prospecierara.ch) and other conservation organizations (www.nutzpflanzenvielfalt.de, www.arche-noah.at, www.dreschflegel-saatgut.de or www.kokopelli-semences.fr), thousands of traditional vegetable, fruit, berry and cereal varieties are propagated for the most part by volunteer employees, varieties for which there are no claims of protection or property, many of which are no longer registered.

Participatory projects

In Holland and France, breeders and farmers working together in participatory plant-breeding projects (PPB) have developed varieties of zucchini, durum wheat (Desclaux et al 2012), potatoes (Tiemens-Hulscher et al. 2012) and broccoli (Myers et al. 2012). More and more traditional varieties are selected

by conservation breeding (Osman and Chable 2007). These programs bring together breeders, gardeners and farmers and enable exchange of experience and training – that is, transfer of knowledge. To date hardly any new varieties have been created. The distribution of varieties of these last conservation breeders is usually limited to small areas. It is niche production with a modest contribution to food production. However, they are very important for agro-biodiversity and the conservation of genetic resources.

Special case USA

In the USA, protection of varieties is regulated differently compared to Europe. Three different laws regulate the property rights (Bette and Stephan 2009). The first, the «Plant Patent Act» (PPA) was introduced in 1930 for vegetatively propagated plants: ornamental plants, trees and vines. The «Plant Varieties Protection Act» (PVPA), a variety protection for plants that are generatively propagated via seed or tubers (potatoes), was created in 1970. In contrast to the PPA, the protection here is much weaker. Until 1994, farmers were allowed not only to reuse seeds from their varieties on their farms, but also to sell them. That is why seed companies in the USA have developed hybrid breeding. In 1985 the «Utility Patent» was developed with the rise of the first genetically modified animals and plants. It provides a comprehensive protection of the property and in contrast to the PPA and the PVPA not only allows patenting of varieties, but also of substances, processes and specific uses. Claims are used to establish wide-ranging property rights – that are often granted – which are usually legally contested by other big seed companies because of the wide range. Against this background, it is understandable that reproducible varieties from seed companies are rarely bred and developed. Last but not least, more than 700 farmers and breeders have joined together (Tracy and Sligh 2014) to maintain and develop such varieties, especially for ecological breeding.

«OSSI is dedicated to guarantee fair and open access to the plant genetic resources around the world to ensure that seeds are maintained and available to all farmers, gardeners, breeders and communities today and in the future».

The Open Source for Seed Initiative (OSSI)

With the following «pledge» OSSI created an original ownership format by which varieties informally receive protection which is morally but not legally binding: «The Open Source for Seed Initiative (OSSI) is dedicated to guaranteeing fair and open access to the plant genetic resources around the world to ensure that seeds are maintained and available to all farmers, gardeners, breeders and communities today and in the future» (see also Kloppenburg 2010, 2013). These are the words with which the initiative introduces its aspirations on its website. OSSI was initiated by Jack Kloppenburg, an emeritus professor in social and environmental sociology in the USA. The promise allows free reproduction and further development without restrictions except that all varieties remain the property of the open source initiative (principle of virality). OSSI originally sought for a legally binding protection, but realized that the US legal system does not allow for it. This lack has not been detrimental to the initiative (Kloppenburg personal communication). On the contrary, it carries

out a considerable public awareness campaign and is currently marketing an assortment of approximately 40 crop species with over 280 varieties (See www.osseeds.org) (Fig. 12).

Figure 12:
OSSI's pledge is printed on every seed bag (outlined in red).

The Open Source License

During the founding year of OSSI in 2012, a first discussion paper regarding the open source principle for seed was developed by AGRECOL (Kotschi and Kaiser 2012). It formed the starting point for the elaboration of a binding legal form of the **Open Source License** (Kotschi and Minkmar 2015, Kotschi and Rapf 2016). Not surprisingly, the legally correct formulation of the license has lost much of the charm of the pledge, both in the length of text as well as in the elegance of wording. With this license, violators of the ownership rights of licensed varieties can in future be prosecuted. There is a search for breeders who would like to grant their varieties an open source license, so that as soon as possible this legal form can be tested in practice.

With this open source license AGRECOL organizes the protection in a parallel new legal sphere, which has not yet been tested. It is unclear what will happen if an open source variety is used by another breeder for further development, for example, in a complex crossing with four different parents from which a new variety is derived. It remains basically the property of the open source community, although the open source variety may have contributed only minimally or perhaps nothing at all to the properties of the new variety (principle of virality). But the reverse can also be the case: a breeder in the open

source community uses a protected variety for a cross. In this case, as the new variety remains in the community, non-members can no longer use it for the development of their own varieties. There is an asymmetry in the scope of the property rights, which can lead to legal confrontations.

The models presented have different implications at the social, political and legal levels. Organizations such as Kultursaat e.V., the Keyserlingk Institute, participatory plant breeding initiatives, seed conservation organizations and OSSI make their varieties freely available without restrictions. The GZPK, the breeding research Darzau and Dottenfelderhof breeding research follow the obligatory legal procedure of variety protection for their varieties, complying with the legal regulations and if possible adjusting them in consultation with other breeding organizations and the authorities.

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The message is clear: seed as a common property can be put into practice with different concrete legal and ownership formats.

Conclusion: Non-profit biodynamic plant breeding has created an impressive range in its handling of property rights and varieties. The message is clear: seed as a common property can be put into practice with different concrete legal and property formats. The principle, which must be taken into account in every concrete regulation, is the differentiation in economic, legal and cultural property with transparent, visible transitions. As this principle is violated in the case of patenting seed, patenting is therefore the wrong approach.

9. Touch points and problem zones

Basically, in the case of the protection of varieties, breeder privilege applies

This privilege states that every breeder must have access to all genetic resources, i.e. to any existing varieties, for the development of new varieties. Varieties with registration and protection may neither be propagated nor marketed without the prior consent of the organization which has developed them. Only for these varieties is the traffic (sales and trade) clearly regulated.

For conservation varieties in Germany, there is a simplified registration and there are quantitative and geographical restrictions. It is unclear how the authorities will manage the «conservation varieties» or «varieties with particular value». There are different experiences depending on which German state is involved.

Some organizations (such as Kokopelli or Longo Mai) are of the opinion that no registration is necessary at all. If, for political reasons, the cultivation of traditional conservation varieties is to be restricted even further, open source communities could ensure their dissemination and sharing, with or without a license.

Large corporations are attempting with all means available to patent more and more varieties from classic breeding methods, in order to make the reproduction by the farmers and their use for breeding by other breeders more difficult or even impossible.

Patents produce legal uncertainty and impede breeding

Large corporations are attempting with all means available to patent more and more varieties from classic breeding methods (Gelinski 2012) in order to make their reproduction by the farmers (farmer privilege) and their use for breeding by other breeders (breeder privilege) more difficult or even impossible. Every small breeder fears claims for damages that may threaten their existence. Although patenting of such varieties is prohibited under European law, the European Patent Office (EPO) in Munich has repeatedly granted patents over the past few years. Approximately 800 other applications, which are often very broad, have been submitted to the Office (Then and Tippe 2011). For example, in the case of broccoli, the protection applies for a «variety of broccoli plants that grow in a field».

In 2015, the patenting of plants from conventional breeding was upheld by the EPO and the patentability of their products was established (Minssen and Nordberg 2015, Saez 2015). On 3 November 2016, in its long-awaited opinion, the European Commission stated that it considers non-patentable any plants and animals from «essentially biological processes» for use in breeding. This statement is in sharp contrast to the practice of the European Patent Office (EPO), which had already granted more than 100 patents for various classic cultivars, not just for broccoli, but also for tomatoes. Governments in Europe now have to ensure that the opinion of the EU Commission is also implemented in legally binding rules for the interpretation of the patent law.

Coexistence: When side by side leads to foreseeable problems

There is always a risk of undesirable cross-breeding of patented varieties. Acknowledged user organizations could demand a cultivation ban or at least seek proper minimum distances. Difficulties arise if their seed is contaminated by unintended cross-breeding with patented varieties – breeders and growers then risk legal proceedings. A few years ago, the case of Percy Schmeiser, a Canadian canola grower, attracted worldwide attention. His varieties were contaminated by the genetically modified RoundUp Ready varieties of Monsanto. He was aware of this, continued to use it, and was convicted of having infringed the property rights of Monsanto (without being fined however). The court decision said that regardless of the way the RoundUp tolerance had found its way into the seed, any herbicide-tolerant plant is the property of the multinational.

10. Ecological breeding and its positive impact on other common goods

Varieties from ecological breeding are important not only for producers in ecological cultivation (Fig. 13). They allow the production of high-quality food with a low level of plant protection chemicals and nitrates, thus contributing to the health of the consumers. The producers largely dispense with the use of resources that are taken for granted in conventional production: synthetic fertilizers, herbicides, pesticides and fungicides. The ecosystem services are therefore significantly higher than in conventional production.

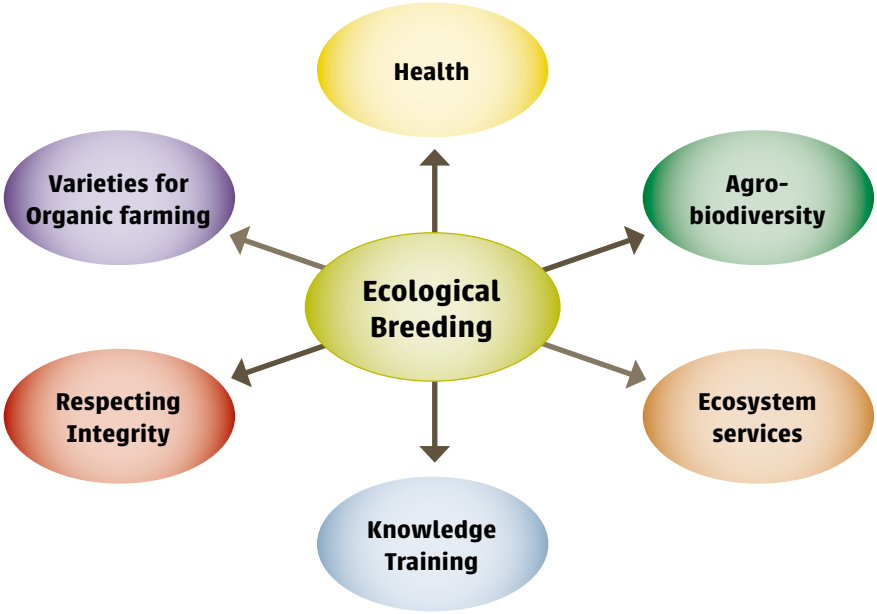


Figure 13:
Biodynamic plant breeding contributes to many other common properties

The plant types from ecological breeding must be able to cope with the available plant nutrients, be able to withstand weeds, and their root structures must be such that mechanical weed control does not interfere with their growth. In addition, they must also be able to cope with a variety of pests by means of resistances or tolerances. This knowledge goes far beyond that of conventional breeding, requires great experience and can be passed on only by the organic-breeders themselves. With the intention of making the potential of crops integral and complete through holistic breeding, ecological breeding makes an ethical contribution regarding the dignity of the plant, a concept which at least in Switzerland is even incorporated in the constitution.

11. Ecological breeding and agrobiodiversity

«Agrobiodiversity: Protection through use»
see the homepage of the German Federal Ministry of Food and Agriculture (BMEL 2014).

Ecological breeding not only protects variety diversity, but also increases it. The seed for organic production from the work and the achievements of organic breeders benefits not only open-minded consumers but also, so to speak, the entire world population.

If the dramatic loss is not only to be stopped, but new diversity is to be created to deal with major issues such as climate change or food security, breeding is the first priority.

While in the past the entire biodiversity could be found in the fields of the farmers and in the (fruit) gardens, it finds itself nowadays more and more excluded from all development in the gene banks and in the vaults of the seed monopolists, as well as in the breeding nursery of each new breeding initiative! The new formation of diversity from recombination and spontaneous variation creates plant types that the future desperately needs. To lead the common property of biological and agro-biological diversity into the future requires all the conservation organizations, the many national and international gene banks, and also the breeders. Agrobiodiversity is also an indicator of sustainable management of our cultural landscapes.

To lead the common property of biological and agro-biological diversity into the future requires all the conservation organizations, the many national and international gene banks, and also the breeders.

Nevertheless, the great importance of ecological breeding for agrobiodiversity goes largely unnoticed. The following facts are illustrative: for the preservation of biodiversity, EU funding of € 408 billion will be provided by the EU's Common Agricultural Policy (CAP) 2014-2020 (EU Commission 2013). Of this amount, 308 billion euros are earmarked for direct payments, about 95 billion euros for rural development for the greening of agricultural production (for a summary, see Melozzi 2014). A small percentage is attributable to producers who cultivate varieties at risk of disappearing. In Europe, efforts regarding agrobiodiversity are restricted to old country and niche varieties. The promotion of the development of new ecological breeding varieties cannot be found in the CAP. At the national level it does not look any better. Money is available only for the public communication of protection issues (Kleinhückelkotten et al. 2006), for the preservation of old local cultivars and for the storage and documentation of crop species and varieties in gene banks. Although in Germany the Federal Ministry of Agriculture and Food, in line with the German Council for Sustainable Development (2011), emphasized the importance of organic breeding for locally adapted varieties (Genres 2016, Dempfle et al 2016), research grants are only available for the conservation of traditional varieties. As at the EU level, the protection of biotopes and habitats enjoys the largest funding at country level (EU Environment 2014).

Lacking funding programs: The newly bred reproducible varieties, the cultivation selection of niche varieties and population varieties, all of which can be found in the programs of organic breeders, are acknowledged as contributions to the conservation and improvement of agrobiodiversity in the CAP, but no corresponding necessity of financial support is mentioned. This deficit is unfortunate because the varieties from the current organic breeding initiatives comply much better with climatic and other changes in cultivation compared with seeds from seed banks which are recultivated only every few years. Organizations that promote and maintain agrobiodiversity at national and international level are important players in the field of agrobiodiversity policy.

Organizations that promote and maintain agrobiodiversity at national and international level are important players in the field of agrobiodiversity policy.

There are three objectives:

- The work of organic farmers is acknowledged and rewarded as a contribution to improving agrobiodiversity.
- EU and national authorities support ecological breeding by giving it the means to protect biodiversity.
- The breeding initiatives communicate to the general public their contribution in the context of agrobiodiversity.

12. Ecosystem services (ESS)

Organic growers are developing the varieties today for a resource-conserving agriculture of tomorrow!

There are always discussions about production costs and values of conventional and ecological production. Comparisons differ according to crops and country. The results published by the US Department of Agriculture (USDA 2016) clearly confirm the benefits of ecological production (Table 2).

	Cultivation	Corn	Wheat	Soy
Gross income	Conv.	689.39	283.89	254.38
Production costs	Conv.	550.34	361.90	278.02
Net profit	Conv.	139.05	-78.01	-23.64
Gross income	Organic	903.53	338.92	434.10
Production costs	Organic	537.26	250.59	326.17
Net profit	Organic	366.27	255.71	107.93

Table 2:
Comparison of gross income, production costs and net profit of three main crops between conventional and organic production in the USA 2010, in US $ per hectare (data from USDA 2016)

In economic terms, the organic production outpaces the conventional production.

For corn and wheat, the costs of organic production are lower than in the conventional ones, whereas in the case of soybeans it is more than 15% higher. In all three cases the profits are higher. With wheat and soy the conventional farmers even suffered losses. Environmental costs are not even included. Economically, the ecological production of conventional production is far superior. What about the national economy? What would happen if the externalized environmental and health costs were included in the calculation? A few figures for illustration: in 2014, farmers in Germany sprayed 123,000 tons of plant protection products onto their fields and used 1.6 million tons of nitrogen for fertilization (BVL 2016). These quantities indicate the toll for maximum output, proving that industrial food production with monocultures, artificial irrigation, chemical fertilizers and enormous amounts of plant protection products entails massive environmental pollution. With the launch of the Millennium Ecosystem Assessment by the United Nations (MA 2005), this production is on the agenda of international politics alongside that of other industries.

The goals for a more sustainable agriculture and for improved ecosystem services (ESS) are:

- Improving resource efficiency in the provision of food, water, wood and fibers
- The slowdown of climate change, protection from floods and diseases, as well as ensuring water quality; environmental protection
- Recreation and tourism, aesthetic and spiritual values
- Preservation and improvement of soil, photosynthesis and nutrient cycles

All these aspects are significantly improved with biodynamic and organic farming. The classification of ecosystem achievements has taken into account the indicators for welfare and landscape, especially in Switzerland (Bafu 2011). With regard to agriculture, the Swiss Federal Office for the Environment is proposing to include organic fertilizers. A few examples underline the importance of the conversion from conventional to ecological farming, which is addressed with the quality of manure. System comparisons between conventional and biological production (Rodale Institute 2011, Seufert et al. 2012) and between conventional, biological and biodynamic production (Mäder et al. 2003) in most cases showed slightly smaller yields in the biological systems However, by reducing the input of nitrogen, energy and plant protection products, the latters ecosystem services were much higher than in conventional systems. Furthermore, two studies have shown that the soil of the biological and biological dynamic group had improved water absorption (i.e. less erosion) and the fixation of CO_2 by topsoil formation was also significantly higher than in the conventional system.
Conversely, many studies show that the ecosystem services of conventional production must be rated negatively in the overall balance (Pretty et al. 2000, Grinvsen et al. 2015, Tegtmeier and Duffy 2004, Zmarlicki et al. 2011, Pretty et al.).

The **optimization** of the production conditions is economically more advantageous than the **maximization** of the yields.

Table 3 shows the externalized costs of conventional production in different countries (according to Zmarlicki et al. 2011). In addition to the costs of conventional agriculture in Poland, the authors also calculated the added value generated by organic production due to its higher market prices as 147 million US dollars. This value represents a fourteen times higher amount for health and environmental costs caused by conventional production!

	US	UK	Germany	Poland
Total cost in million $	47,787.3	3,946.3	2,796.0	2,134.8
Costs/Hectare in $	111.4	350.3	161.4	129.4

Table 3: Conventional agriculture causes environmental and health costs associated with the following: pollution and drinking water treatment, over fertilization of crops, air pollution, greenhouse gases, erosion and humus losses, biodiversity and degradation of cultivated landscapes, health and pathogenic bacteria and viruses in food. Data from Zmarlicki et al. (2011)

Impressive results were also recorded with a two-, three – and four-year crop rotation in corn and soybean cultivation over nine years (Delbridge et al. 2011, Davis et al. 2012). Compared to the two-year crop rotation with a large input of fertilizers and plant protection products, the two other crop rotations showed a reduction of nitrogen fertilization by approx. 85%, of herbicides by almost 90% and subsequently a 200-fold lower contamination of drinking water with plant protection products, as well as halving the applied fossil fuel used.

Adapted varieties for organic farming can be developed only if they are regularly cultivated and selected under organic or biodynamic conditions.

What do ecosystem services have to do with ecological breeding? There are a number of characteristics that have been integrated into the selection system by the organic farmers, such as:

- Development dynamics in accordance with the availability of mineralized nitrogen improve the nitrogen efficiency
- Fast ground coverage to reduce weed pressure and for strong ground heating by direct exposure to sunlight
- Tolerance for and resistance to diseases and pests

Adapted varieties for organic farming can be developed only if they are cultivated and selected regularly under organic or biodynamic conditions (Lammerts van Bueren et al. 2011, Lammerts van Bueren and Myers 2012, Messmer 2014). This takes into account the close link between location and variety, between yield stability and varying environmental conditions. In the age of trade in carbon emissions certificates, restoration of rivers and flood-

plains for flood protection, eco-compensation and other ecological promotion measures, crop breeding, which enables saving of resources and even improving production, deserves a key position among ecosystem services. The main objectives are:

- Forming alliances with governmental and non-governmental environmental organizations to recognize and support ecological breeding in the improvement of ecosystem services.
- Communicating the positive achievements and the importance of organic breeding for ecosystem services to politicians and the public.
- Lobbying with the slogan: Organic growers are developing varieties today for a resource-conserving agriculture tomorrow!

13. Proposals for financing private and non-profit plant breeding

Depending on the region and the political framework conditions for agriculture and individual crops, different financing concepts have been developed. On the one hand there are state monopolies; on the other hand, governments leave breeding activities completely up to market dynamics. In view of climate change, the unimpeded loss of biodiversity among cultivars as a vital basis for food supply and the global monopolization in the seed and food industry, there is growing awareness of the importance of public interest-oriented, non-profit plant breeding among politicians, businesses and the general public.

The search for new viable concepts for financing a diverse, community – oriented cultivation of plants is linked to all stakeholders, beyond just government and market, assuming responsibility for the urgent tasks. Fig. 14 exhibits the strengths and weaknesses of the concepts regarding the three characteristics of seed. Seed always has a **market value**, and is therefore a commodity to be bought and sold; it therefore also serves as a means of production. In the same seed package is also a variety, a **legal property**, which normally belongs to another owner. At the same time the seed grains form a genetic resource for the further development of the crop as such. This means that seed is at the same time a **cultural property and heirloom of mankind**, which belongs to all and at the same time to nobody.

The three types of property are differentiated in different groups of users, which accordingly share the overall responsibility. The market value of seed relates to concrete buyers, the legal property variety relates to the seed propagators and the cultural property relates to the whole of mankind. In contrast to the simple, conventional business model which handles the financial flow solely at the «bottleneck», which means at the seed buyers, a broadly distributed parity financing emerges in which all stakeholders participate according to their responsibilities (See Fig. 17).

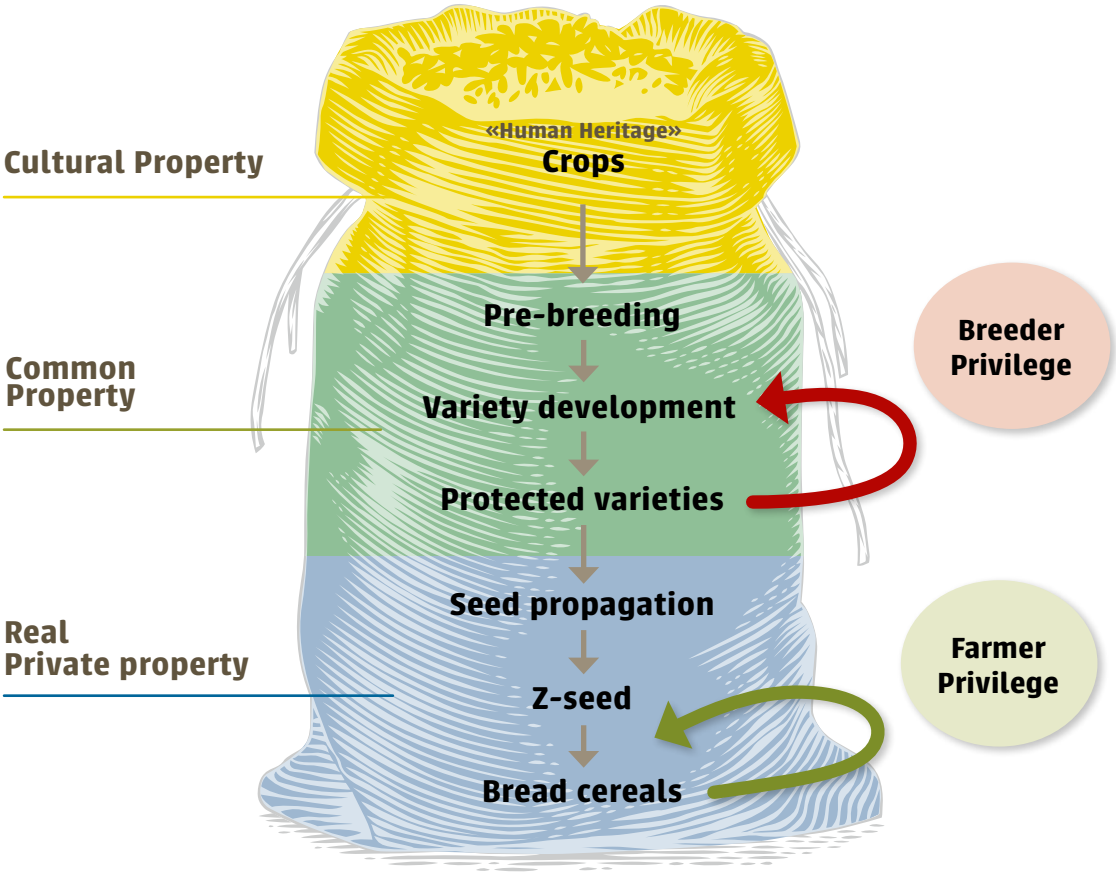
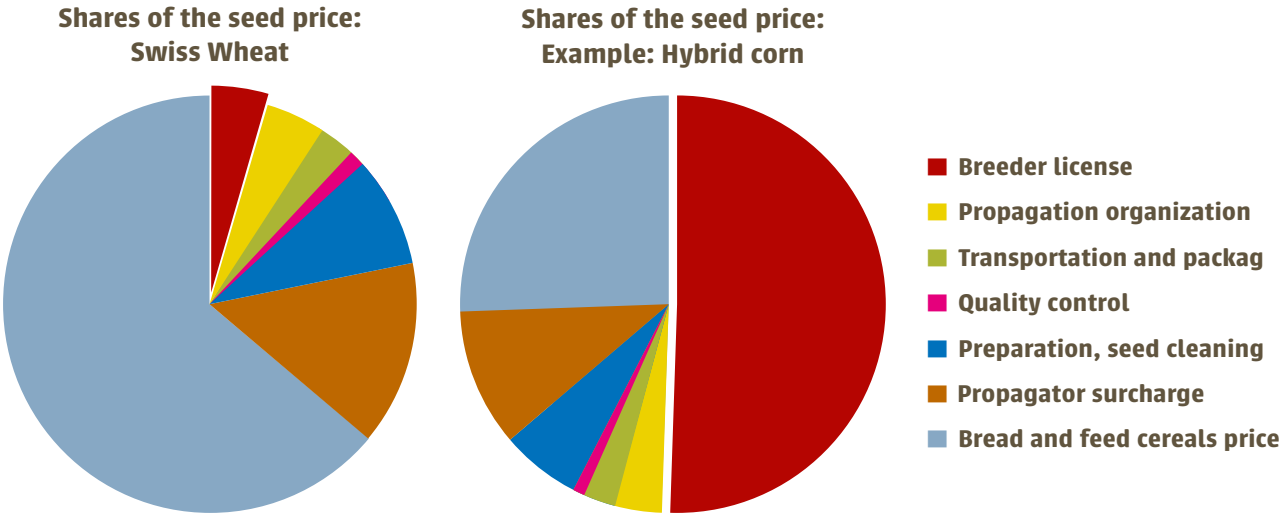


Figure 14: Variety protection according to UPOV regulates the connections between the cultural property of the plant genetic resources, the legal property variety and the economic crop seed. There are two essential exceptions: the breeder privilege guarantees access to the cultural heritage, and the farmer privilege to its use for personal needs.

License fees for seed under certification

For most plant breeders in Europe, protection of varieties is a self-evident practice for legal property in accordance with the established UPOV convention, as it protects the breeder›s work and represents the classic way of financing ongoing breeding efforts. In the case of ordinary crops, depending on the crop, type of variety and cultivation region, the license fees amount to between 10% and 70% of the seed price or 10-200 Swiss francs per hectare (See examples in Fig. 15 and 16.). In the case of profitable cultivars, the licenses may be significantly higher, and the seed companies secure a share of the income that belongs to the farmer or gardener through seed licensing. There is no reason to fear cheaper competition or the cartel authority.



Figures 15 and 16:
Seed pricing and share of the breeding license for reproducible wheat and hybrid corn.
In the case of wheat, the bread cereal price and the surcharge for the work of the propagator are the main factors, the license being approximately 10% of the seed price. In the case of hybrid corn, five times as much money flows into the pockets of the breeders per hectare, even though the feed crop value is much lower.

The advantage of the seed licensing fee for financing breeding lies in the unavoidable «bottleneck». If the farmer does not have his own seed, he has no choice but to buy it. Seed is thus an essential means of production with a price that has to be paid long before something grows and can be sold – usually only a year later. The «bottleneck» (Fig. 15 and 16) is therefore a source of unfair trade, especially because the other financing channels are underdeveloped. To make it clearer: it is an abuse of power in seed pricing. **Whoever has the seed has the say!**

This is problematic where seed of protected varieties is used in a subsistence economy, because it is then usually too expensive in relation to the achievable selling prices for the products. For this reason, in subsistence farming an informal seed system predominates, i.e. seed has no price. It is not a commodity at all, but is exchanged or given away. However, this often prevents the breeding of improved varieties and the production of high-quality seeds, since training and exemption of qualified persons for these vital tasks are financially impossible. To find the right format for resolving this problem is a major challenge for development projects and the establishment of user communities. Also disadvantageous in the case of seed licensing are the downstream value-added stages. They place very high demands on the processing and marketing quality of the raw plant materials, but do not directly contribute to the breeding costs which are necessary if these demands are to be fulfilled. In order to cover the cost of the breeding work, buyers and traders would have to participate. Usually, there is no awareness of this with either of them.

It is therefore mandatory to implement either a fair system of price building or better, to install a direct and equitable sharing of the additional value with the breeders, which can be achieved thanks to the characteristics of the varieties (Fig. 17). The fact that some 50% of the breeding costs for new quality varieties cater for the requirements of the partners of the value chain, argues in favor of their direct financial participation in the costs. This view could be discussed and implemented on the basis of the IAD.

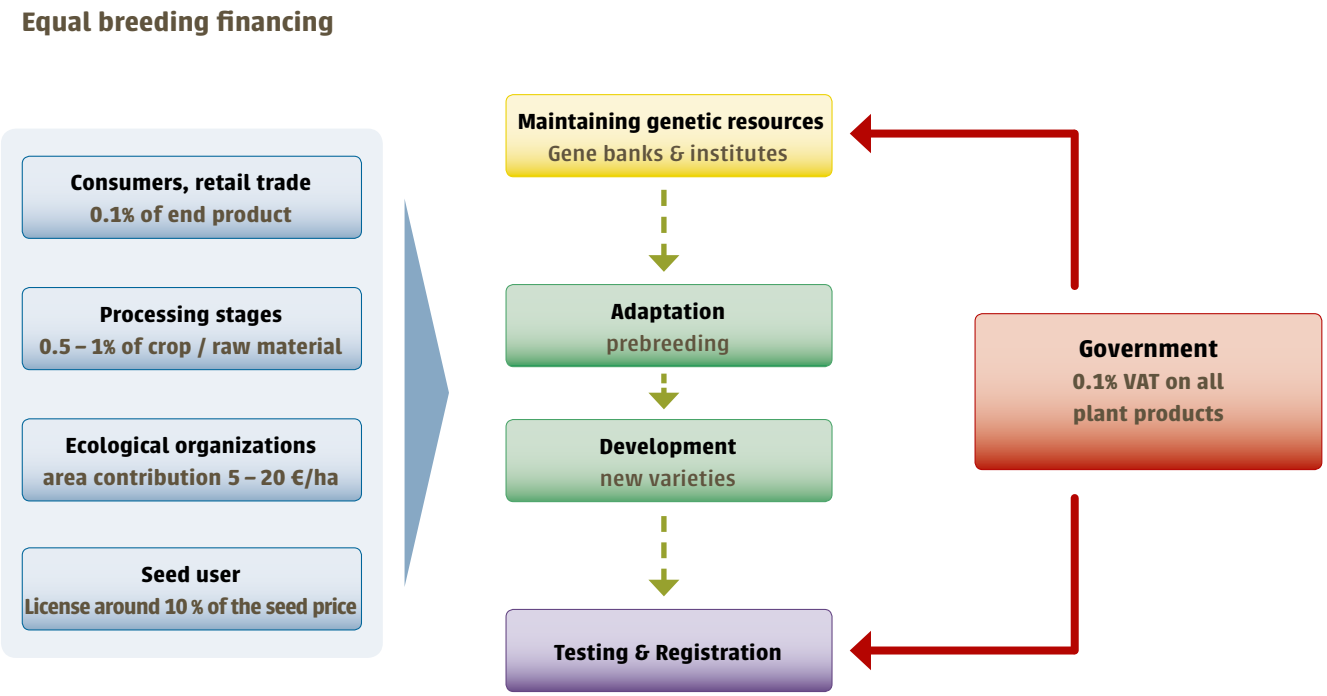


Figure 17:
Parity financing should be provided by all partners of the value-added chain (blue). In accordance with its responsibility for cultural assets and transparency in the seed market, the government should also contribute (red)

The situation is a bit different with the value of the biodiversity *in situ* supported by organic breeding and ecosystem services provided by adapted and efficient varieties. These too are priced into the value chain and thereby also eliminated from consciousness. As a consequence, it is more or less tacitly assumed that the achievements for these two common property goods are to be provided for free. Conversely, higher prices are justified vis-à-vis consumers with just these arguments. Therefore, for the common good, the question should be discussed of fair pricing across the whole chain or a direct sharing of the extra price with the actual service providers, that is, the breeding organizations. If one digs a bit further into this issue, it can be seen that the breeding costs are always included in the raw material purchase and – as long as cultivated cultivars are used during the production – end up in the pockets of the conventional breeding companies. If we calculate an average of 0.5 to 1% breeding costs on the raw material purchasing value, it is clear what amounts are involved. With a purchase of raw materials of 300 million euros at a bio-wholesaler, the breeding costs amount to 1.5 to 3 million euros annually! On the one hand, it is up to the purchasers to demand products from ecologically cultivated varieties and to use their leverage to ensure that the money flows into the right pockets. On the other hand, in these circumstances an incentive tax for the promotion of ecological breeding must also be considered.

Again and again, the question is asked if registered non-profit plant breeding institutions should be allowed to incorporate license fees in their budgets at all. Opinions and argumentation vary according to country, financial authority and expert, and they sometimes also vary according

to the political balance of power. Therefore, there is a high degree of legal uncertainty. Here, only a few important points are mentioned, since the full details are a legal specialty and would be beyond the scope of this study. As shown in Chapter 6, the breeding itself does not produce any commodity. This and the realizable added value arise only through the seed propagation in specialized, profit oriented enterprises. This division of labor is a major key and is also practised at universities and public research institutes for technical innovations. To a certain degree, license revenues from the tax authorities are classified as commercial and limited to a maximum amount. The General Financial Directorate in Zurich has a different view. It argues that the non-profit of the GZPK should only be reassessed when the majority of the income of the association comes from licenses. But even then, it would be necessary to examine first what these revenues would be invested in. If they were used to satisfy non-profit activities for the benefit of the general public, then the charitable status would still be valid. Another argument in favor of licensing varieties is that non-profit organizations cannot do without it, since price distortions in the seed market would be inevitable and result in a disadvantage to those peers who are not non-profit breeders.

Reproduction – lack of fairness with fatal impacts

Unresolved in the seed licensing system is the reproduction of easily propagatable cultivars such as cereals, beans, peas and lupines. If the farmer uses part of his crop as a seed for the production of a commodity, he appropriates the breeder›s work without paying for it. This is also true for biodynamic cereal breeders. In Germany alone, farmers avoid payments of an estimated 300,000 euros annually, an amount that could finance a whole share wheat breeding program. Not least because of this shortfall, breeders rely for their projects on the support of private donors, the seed fund and foundations. According to the UPOV convention, breeders are generally entitled to a fee from the user, but this is often not understood at the grassroots level by the farmers and is therefore not accepted.

If a farmer breeds a variety because it satisfies his wishes and the quality requirements of his customers better than any other variety and guarantees a profit margin, in all fairness the breeder is entitled to a fee. However, if the reproduction is controlled, a system similar a police state is created, poisoning the relationship between farmers and breeders – a relationship that should be based on partnership! Voluntary agreements for propagation contributions or surcharges on Z-seed licensing may be accepted by practitioners. However, a sustainable flow of funds to the breeders, which should equal a multiple of the Z-seed licenses in regions with a high rate of use of farmer saved seeds, is prone to fail. In France, 0.7 euros per ton of cleaned raw material is generally retained by the millers, and is distributed by SICASOV (Société Coopérative Agricole des Sélectionneurs Obtenteurs

de Variétés Végétales) according the seed propagation areas to the breeders or the owners of the varieties. By doing so, a continuous return flow for soft and hard wheat, barley, oats, rye, rice and spelt is generated. To circumvent this rule, thousands of farmer-bakers (paysan-boulangers) have appeared in France, who are allowed to process and market their own crops of old and often new and protected varieties without paying. Many organic farmers are also moving into this niche. This is the reason why organic breeding and ecological seed economy have hardly been able to develop in this large region of grain production. This situation has not only economic consequences. The unresolved problem of reproduction is one of the main reasons that cultivars such as peas are hardly ever subjected to improvement by continuous breeding. At the same time, it is a very powerful driving force for many breeders to offer only hybrid varieties. With hybrid seed they ensure the continuous refinancing of breeding activity. However, the legal property «variety» is replaced by a mere economic asset.

If a farmer grows a variety because it satisfies his expectations and the quality requirements of his customers better than any other variety and guarantees a profit margin, the breeder is in all fairness entitled to a fee. However, if the reproduction is controlled, a system similar to a police state is created, poisoning the relationship between farmers and breeders – a relationship that should be based on partnership and trust!

Levies and incentive taxes to promote breeding

As a producing and processing coalition, the organic farming associations are the sovereign of the entire ecological movement. They have to ensure that the expectations of the consumers for the products are satisfied not only by the advertised image of the products, but also are associated with actually delivered performance. For this reason, in 2010 Bio Suisse delegates declared that organic breeding is a core task of the association. Since 2014, Bio Suisse has also developed a timetable and provided funding to replace in the long term hybrid varieties generated with CMS. As soon as alternatives are available, the association is likely to abandon such varieties completely.

As we have seen above, the expectations of consumers for the varieties and seeds used is far ahead of reality. All associations have a lot of catching up to do in order to solve the problem of authenticity. Therefore, levies and incentives have been developed to promote organic breeding. However, a satisfactory solution has so far been available only in Switzerland. With the argument that all cultivars must ultimately be developed organically and that they should not be left to anonymous and blind market forces, general area contributions of 20 Swiss francs per hectare will be applied. This allows Bio Suisse to promote general breeding and specific variety development projects. The argument mainly focuses on seed as a cultural property since it is misjudged in the ordinary market. The funding periods for these measures should not be less than 3 to 5 years.

Another instrument is the incentive tax on conventional seed – which is often cheaper than biologically produced seed – as well as on conventionally bred varieties, which supports the development of organically adapted varieties. Estimates of Wilbois (2013) show that an incentive tax after deduction of administrative costs could generate more than 6 million euros in Europe alone. All levy and insensitive measures are subject to the same flaw – they are connected with additional administration and control costs. With respect to the high potential for damage to the whole of organic farming, the associations are obliged to find a solution quickly and to justify the additional expenditure and levy to compensate for granting exemptions. The incentive tax is initially a democratically determined market intervention to create comparable conditions for all growers. The problem justifies the use of the financial means for its long-term elimination.

In society, awareness is growing that organic breeding provides a wide range of societal achievements that cannot be financed entirely from the flow of goods.

Direct participation of companies in the value chain

Public awareness is growing that organic breeding provides a wide range of societal achievements that cannot be financed entirely from the flow of goods themselves. For many organic food processors and retailers, sustainable and fair production is part of the corporate image which they sell daily to consumers together with ecological products. As direct users, they recognize the great importance of breeding for the quality of the products and their authenticity. If this recognition is implemented, the demand for biodynamic cultured varieties will grow. The effect of this increasing demand on the upstream partners is very strong. In many places, possibilities are examined of how processors and traders can contribute directly to the promotion and support of organic plant breeding: In the Fair Breeding Initiative (Kultursaat 2016) partners commit to transferring 0.3 percent of the vegetable and fruit net turnover for ten years to the organic breeding initiatives. In Switzerland, processors and retailers have been working together with ecological breeders and seed propagators for 13 years (Coop 2016). These initiatives have helped to improve biodiversity in cultivation, processing quality, nitrogen efficiency, and consumer expectations. The support provided by the Coop Fund for Sustainability is oriented to both the future and performance, and is very effective in both respects. This project has led to a very high acceptance of organic breeding, the highest in Europe. Approximately two-thirds of Swiss organic wheat production originates from varieties of biodynamic breeding. Once again, the periods of funding by companies in the value chain should not be less than 3 to 5 years

The task of non-profit foundations

Foundations cover a large part of the funding of non-profit ecological plant breeding. According to the investigations of Kotschi & Wirz (2015), in Germany and Switzerland this amounts on average to more than 50%, and in some cases up to 80% of the budget. In view of its importance to society as a whole, the use of foundation money as an investment in the future is only logical. However, foundation-based funding can also be prob-

lematic, because it must be more than «helping people help themselves» and kick-start financing. Large investments in infrastructure are required, and long-term commitment is needed for those engaged in ecological breeding. The long development cycles of often 10 – 15 years for a new variety needs both continuity and durability in financial support. In addition, breeding is never completed, but is a continuous process of monitoring crops. It must be mentioned that the increasing and, based on only one-year commitments, recurring administrative expenditure in the use of non-profit foundation support is time consuming and often involves only relatively modest subsidies. If foundations want to engage in plant cultivation and to achieve sustainable funding, they must grant long-term funding periods of 3 to 5 years. Based on history and structure, each foundation has its own characteristics, often shaped by the founder him or herself. The **seed fund** of the Future Foundation Agriculture deserves special mention (www.zukunfts-stiftung-landwirtschaft.de/saatgutfonds/). A continuous increase in the number of private donations and company contributions over the last 20 years has enabled the fund to promote specific breeding projects and to intensify public relations. This very positive development is due to the commitment of donors, breeding initiatives and organic farmers' associations. Together they face the challenge of further strengthening organic breeding and the use of their varieties. The seed fund is committed to a further increase in the annual donation sum, stronger public support for organic breeding research and the development of new financing instruments.

For the long production cycles of often 10 – 15 years, breeding needs both continuity and durability regarding financing.

Governmental funding of breeding

Since the fall of the Iron Curtain and in the course of globalization, almost all European countries have reduced their support to small breeders. For example, 30 years ago, Switzerland still had a state-owned bread cereal production monopoly and wide range governmental breeding of wheat, spelt, triticale, soy, corn, apple, grapevine and several varieties of vegetables. There is not much left of this, and it would not come as a surprise if it completely disappeared in the next five years, despite a differently stated plant breeding strategy. At the same time the same government spends billions on promoting biodiversity and ecosystem services!

While molecular breeding is strongly promoted worldwide, although it is known that it does not solve the problems at hand but makes them worse (Russell and Hakim 2016), practical breeding is less and less supported. ETH Zurich has created a new professorship for molecular plant breeding and is planning a new research center (ETHZ 2016). The large national breeding research financial pots in Germany and the EU programs are emptied mainly by large breeding companies and consortia, since the administrative costs for small and medium-sized enterprises are disproportionately high.

While molecular breeding is strongly promoted worldwide, although it is known that it does not solve the problems at hand but makes them worse, practical breeding is less and less supported.

In the wake of the problems of the ever dwindling agrobiodiversity, many countries have committed themselves to the genetic resources of the native crops by signing the Nagoya protocol and the international seed treaty of the FAO (ITPGRFA). Until now, this commitment was mainly restricted to conservation measures and the characterization of collected gene bank materials. People only slowly realize that the stored material quickly loses its cultivation ability and becomes worthless when it is withdrawn from constant interaction with the changing conditions of cultivation and climate.

For all plant genetic resources, additional pre-breeding programs must be established to allow plants to interact and keep up with the development of the environment.

In Switzerland, initial projects of this kind are being launched under the **ational Action Plan (NAP 2016).** The promotion of such programs is fully in the public interest, since it is the preservation of a living cultural property as a resource for the breeding of cultivable varieties. Although seed monopolization and the consequences of advancing climate change have been widely recognized, little has been done at the political level to provide funding for pre-breeding and practical breeding. In the Swiss National Council, Maya Graf, member of the Green Party, has proposed continuous cultivation of the 60 most important crops in Switzerland and has received broad political approval for this proposal. As a result, the Federal Office for Agriculture let experts develop a plant breeding strategy, which was also received with great interest in the German Bundestag (German Bundestag 2016). The strategy provides not only a sound justification for the public promotion of plant breeding, but also outlines aspects and criteria for prioritizing the cultivars to be bred. Breeding is to promote sustainable and resource-efficient agriculture and to support its adaptation to climate change.

Even before the publication of its plant breeding strategy, the budget for the official variety testing in Switzerland was severely reduced. As a consequence, breeders of new cultivars may have to wait many years for admission of their varieties.

The governmental tasks are not only rooted in the direct support of breeding, but also in shaping the political environment, in ensuring solid and practice-oriented professional training and an open and inexpensive certification of variety registration and testing. Only in this way can reliable information be made available to farmers, advisory bodies and partners in the value-chain. Neutral information about varieties is the first prerequisite for building a broad range of varieties that will find their way to farmers, processors and traders. Even before the publication of the plant breeding strategy, the budget for the official testing of varieties in Switzerland was severely reduced. As a consequence, breeders of certain cultivars may have to wait many years for admission of their varieties.

The public facilitation of plant breeding must be realized for the following national political reasons:

- Perception of international responsibility for the diversity of crop plants, also vis-à-vis developing countries
- Lack of access to genetic resources and seed monopolization as a threat to democratic self-determination (sovereignty)
- Availability of neutral information on varieties for users as a protection for a transparent seed market
- Preservation and further development of crop competence in the region (training at all levels, knowledge transfer on crop plants and plant breeding)
- Regional and national food security, crisis prevention
- Precautionary principle: prevention of damage, promotion of environmentally friendly production methods, development and provision of diversity and alternatives
- Conservation and development of biodiversity at several levels (landscape, region, species, varieties)
- Securing essential and valuable ecosystem services
- Improving resource efficiency (soil, nutrients, water, operating resources in agriculture)

The crop plant per mille – Participation of consumers

All food, including animal feed, is ultimately made from cultivated crops, which are invariably adapted by breeders in elaborately detailed work and with a strong commitment to ever-changing conditions and needs. In the end, all consumers are directly or indirectly beneficiaries of breeding. This makes it possible to establish a general cultivar premium for the whole of food conversion and for technically processed plant products (fibers, fats, oils, etc.) in favor of breeding which feels obliged to the common good.

The crop plant per mille could be a very efficient and long-term financing solution which can be implemented directly through value-added tax

The cultivar premium is a kind of basic pension for the long-term breeding of all cultivars, beyond commercial interest and success.

In Switzerland alone, 0.1 percent (one per mille) would result in a substantial subsidy of non-profit plant breeding of some 30 to 40 million Swiss francs per year. Such VAT does not hurt anyone and is not at all noticeable in the price calculation of the products! Interesting in this context is the comparison with the demand of Maya Graf. According to the Swiss Federal Council, the continuous breeding of the 60 most important crops in Switzerland would cost around 10 to 15 million Swiss francs per year, in addition to the current 4 million Swiss francs of the plant breeding costs that is transferred to governmental institutions (see Plant Cultivation Strategy (i.e. excluding Syngenta), September 2, 2016, p.11). Today, all non-profit breeding companies (without Syngenta) together spend around 6 million Swiss francs annually.

The crop plant per mille could be a very efficient and long-term financing solution which can be implemented directly through value-added tax. It does not necessarily require a governmental, i.e. politically accepted majority solution. There are wholesalers who want to incorporate this premium directly at their sales points and to proceed with a non-profit plant breeding initiative at their discretion. The federal variant of the general obligation imposed by the state can also be based on the voluntariness of an autonomous user community.

Conclusion: Each financing concept for plant breeding has its own meaning and quality for the respective user community. In addition to the licenses connected with the seed, i.e. imposed directly on the variety, on the one hand the partner companies of the value chain and on the other hand the farmers› associations themselves are obliged to compensate for the services provided by the breeders with a fair amount of equal involvement. In addition, there is the responsibility of ensuring and maintaining, now and in the future, the common and cultural property of crops in the public interest of sustainability and healthy development. In this case, non-profit foundations, and above all the states and global institutions, must become active, because privately operating companies are externalizing this task. In this respect, the crop plant per mille could be a very simple and effective tool for solving shared duties.

14. Future scenarios for the north

Within 10 to 20 years, the whole world will ask for varieties of ecological breeding.

The future scenario cannot be based on the status quo of organic breeding. Rather, the needs of global ecological agriculture and farming as a whole must be taken into consideration. In the next 5 to 15 years, a sufficiently broad range of varieties has to be provided for all crops and for the entire ecological arable and vegetable production worldwide. In order to achieve this, the breeding activities must be increased at least ten to twenty fold. The organic seed economy will develop in parallel with this. As long as no organic varieties are available, conventional cultured varieties would have to be propagated and used. The many positive «side effects» of ecological breeding (agrobiodiversity, ESS) for seed as cultural property do not form an independent scenario, nevertheless they must not be lost sight of.

What are the elements of future development?

Geographical expansion of breeding work

Some initiatives have recognized the problem and started recruiting additional staff and creating new sites. For historical reasons, Kultursaat e.V. has breeding and propagation sites throughout Germany. On the other hand Sativa Rheinau and the GZPK conduct breeding and research projects with subsidiaries in Germany and now also in Italy. The existing initiatives have to extend beyond the German-speaking regions and new initiatives have to be started. The main demand for ecological seed will come from North Africa

and South Scandinavia on one side, and the Caucasus and West Africa on the other. Ecological breeding must be able to serve this huge new region with its range of varieties. A key element must continue to be the integration of breeding in established organic farms, so that the synergies between livestock farming, soil fertility and agriculture can be exploited. Within 10 to 20 years, the whole world will ask for varieties of organic breeding.

Training of future breeders

Biodynamic breeding is based on classical breeding methods and, by means of modern analytical techniques, refines both the choice of parentage and the selection. The integration of countless individual data into concrete selection decisions requires the cultivation of an individual view of an arable crop, the «breeder's view». The goals personally influenced by the breeder are the starting point for the his or her biography and thus the source of creativity and diversity, as well as a prerequisite for the responsible handling of the chosen crop plants. In this sense, programs are set up that allow trainees to find their own path in close connection with breeding practice. Breeders are said to be «difficult personalities». This is perhaps even especially true for biodynamic breeders, but it is at the same time their quality brand and the source for creating new biodiversity.

Breeders with their activities should also be perceived as part of cultural life – similar to art such as painting or theatre.

Similar to established degree programs at universities and technical colleges, such courses can also be financed from state sources. The experiential knowledge and the transfer of knowledge from organic breeding is to be understood as a common property; the more it is used and multiplied, the more fruitful it is for the general public.

Cooperations with partners of the value chain

Breeding always builds a business embedded in the socio-ecological environment. Cooperation with the «neighboring» partners is obvious and can be intensified as desired. This gives plenty of scope to individual initiatives and is an important step towards the expansion of the spectrum of cultivars. This challenge can be tackled only when existing small and medium-sized breeding and seed companies are convinced about and converted to organic breeding. Another advantage of cooperation is proximity to the needs of processors, dealers and consumers. If projects are jointly coordinated with these actors, specific product developments can not only be realized, but also the partners can become «ambassadors» and fellow initiators of the common task.

Differentiation, rationalization, coordination and networking of activities

In view of the new challenges of climate change, eroded and degraded soils caused by industrialized production systems, selection at multiple breeding sites is of utmost importance. In the past, this kind of selection has been tested in small projects and validation tests. Not least for the expedient use of limited resources, it is essential that there are consultations among the ac-

tors about cultivars and varieties and new breeding programs, as well as the sharing of breeding material and technical resources for regional selection at several locations.

To this end, suitable platforms have to be developed. At the same time however, the individual initiatives should remain as independent as possible both in technical and economic terms to ensure diversity and autonomy.

Public Relations for ecological breeding

Many direct and indirect benefits of organic breeding are, as shown above, not very well-known internally i.e. in associations and by the partners of the value chain, or externally by politicians and by government agencies such as ministries and offices. Ecological breeding needs a lobby! At national and international level, additional synergies and sources of financing can be opened up through communication efforts. In some European countries, research facilities for ecological farming already benefit from state funding. Breeding research at universities of applied sciences must increasingly be extended to practical breeding work, i.e. to the development of new varieties. By integrating these bodies as active partners in the common future task, a substantial boost for ecological breeding is possible.

Often organic and biodynamic breeding is supported by foundations and individual sponsors as a **contribution to culture beyond economics and production.** They perceive this type of breeding as a manifestation of respect in the handling of crop plants and consider this to be a core contribution to the future food supply. Whether organic breeding tends towards the precautionary principle or is a contribution to culture , is a matter for discussion. In both cases it must be communicated that breeders with their activities should also be perceived as part of cultural life – in the same way as are the arts such as painting or theatre. ■

Sowing the future! Campaign
Waidhof, Zurich, March 2008

Cowpea seed produced by a women's cooperative,
Mopti Region, Mali (Image: Eva Weltzien)

D. Seed, Varieties and Agrobiodiversity in Developing Countries

1. The significance of farming communities

Agrobiodiversity and food security in developing countries are in the hands of small-scale farmers who farm less than two acres of land (FAO 2014 b, Penn State University 2015). This seems surprising at first, since it has never been a goal of the farmers to produce a diversity of cultivars and varieties. Their efforts are still aimed at securing food for their families and communities. More or less consciously, they work according to three principles, which guarantee both the yield security and increase of the diversity of varieties.

- For a specific arable or vegetable crop, always several different varieties are grown. Because they differ in agronomic properties, such as the time of maturity, water requirements etc., maximum yields cannot be expected, but there is no need to fear total loss of yield.

- The exchange of varieties with other production communities allows for testing new varieties and thus for the expansion of the cultivar spectrum. Nowadays the original form of subsistence farming exists only rarely. Whenever possible, producers sell the surpluses of their production in the local markets. However, as we shall see, seed markets and seed exchange are still common practice. Both serve not only the exchange of grains and seeds, but also of experience regarding special characteristics and demands on soil and weather conditions.

- For production, farmers most often use seeds from their own reproductions, but they also resort to seeds produced outside their communities. For breeding, their own varieties are only of limited value. Due to repeated selection in the field, they are genetically quite homogeneous and thus exhibit only low variability. The free exchange within and outside the community is the most important source for the development of new varieties. However, also commercial varieties from the seed trade and from public seed banks are appropriated. In the case of the last two sources, problems with the owners-

hip of varieties can occur due to variety protection or public access (see below). The importance of local production communities for the maintenance and development of seed in Africa is shown by Almekinders and Louwaars (2002) and Mayet (2012) (Table 4).

Origin of varieties	Characteristics	Varieties for cultivation	Varieties for breeder
Own	Quality is known, always available	+++	---
Neighbors, friends and family	No cost, available without any problems	++	+
From others in the community	No cost, easily available, not always easily available (depending on social status)	+	++
Local market	Quality is unreliable, used only in case of emergency	--	---
Traders	Available without money or with possible credit	+ , –	– , +
Neighbors, friends, family (outside the community)	Can be available without cost, but, subject to travel expenses	+	+++
Shops and commercial organizations	Cost for buying seed and for travel	+	++
Seed agencies, Public seed sector	Unreliable availability, Unknown quality	-	+++

Table 4: Rural communities and their seed: seed exchange and seed purchase are the sources for new varieties. From +++: generally very suitable to +, – : acceptable suitability depending on situation and – --: generally unsuitable (Almekinders and Louwaars 2002)

- Finally, the seed production and reproduction of own varieties is a common practice, which in the medium term always results in locally adapted varieties – a biological basic law. This conclusion is suggested by an impressive study of wild emmer wheat and barley (Henry and Nevo 2014). In a comparative cultivation in Israel, varieties were tested, of which grains were collected at the same sites in 1980 and 2008. In just 28 years, all varieties began flowering several days earlier (Fig. 18) as a result of climate change.

With these statements, the importance of approximately 1,500 gene banks, in which thousands of varieties are stored worldwide, is by no means diminished. The *ex situ* preservation of seed is an important building block for the conservation of genetic resources, even if it presents an emergency solution.

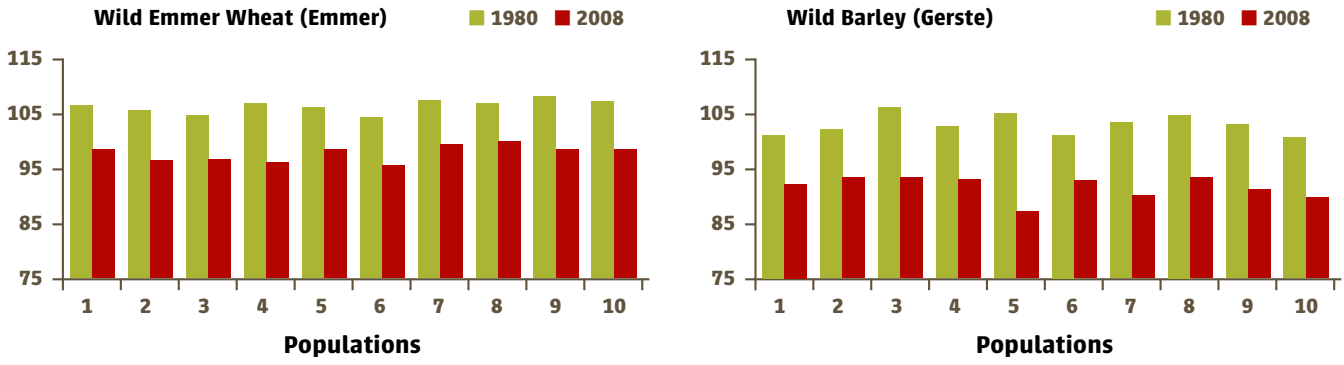


Figure 18:
Changes in the beginning of flowering in emmer (left) and barley (right) in days after sowing within 28 years. The x-axis shows the populations numbered from north to south.
From: Henry and Nevo (2014), modified.

Because sowing of these samples is logistically only possible every 10 years, if at all, they are only poorly adapted to the rapidly changing environmental conditions, especially of climate and soil. However, this does not mean the reintroducing of thousands of cultivars and varieties that have originally existed for cultivation. The clock cannot be turned back. It is high time though to preserve the cultivation of the approximately 200 species that can still be grown today and thus to expand as quickly as possible the spectrum of 12 crops with which 75 percent of the total food is produced. It is indisputable that intact production communities play a central role in the use, conservation and further development of crops, which will become even more important in the future!

It is foreseeable that because of climate change and migration of many young people to the cities, yields have to be stabilized and increased. This requires breeding progress and thus support from experts, as well as from non-profit plant breeding and participatory selection projects. In addition, the causes which led to this major reduction must be corrected. This includes curbing the rapid expansion of industrial agriculture with its few high-performance varieties and the often accompanying privatization of varieties by hybrid breeding and patents. Furthermore, Western eating habits, which are displacing local nutrition systems (FAO 2012), should not be promoted as a global standard.

The loss of agrobiodiversity is always linked to lack of use. It is therefore of central importance to investigate which conditions impede use and which ones promote it.

2. Food sovereignty and its importance

The concept of food sovereignty was coined in 1996 by the international small farmers' organization **La via campesina,** to express their criticism of the heteronomy of the international trade rules of the WTO and of the neoliberal credit requirements of the International Monetary Fund and the World Bank (Haerlin and Beck 2013). «Food sovereignty» was included in the World Agriculture Report (2009). It means not only the right to food but also the right to its production. The report calls for additional measures to protect and improve soil fertility and programs for the conservation of traditional, adapted agricultural management practices in developing countries (IAASTD 2008). The recommendations take into account that around 70 to 80 percent of all foodstuffs are produced worldwide by 570 million family businesses, which, in 72 percent of the cases, have less than 1 ha of cultivated land (FAO 2104 b). In view of these figures, the claim that industrial agriculture and high-performance varieties make a significant contribution to global food security is false. Regardless of their importance, these family businesses are under threat from numerous sides. They are threatened by land grabbing of private and public sector investors, free trade agreements, seed regulations and international treaties.

3. Many problems

The most dramatic threat is the appropriation of land (land grabbing) in these countries. Since 2008, GRAIN (2016) has followed the process of expropriation by governments, investor groups and seed companies. Until the beginning of 2016, there were almost 500 sales transactions with more than 30 million hectares of land in 78 countries (Fig. 19). In the meantime, it is no longer just about food security for rich nations, but also about CO2 certificates, raw materials, water, seed or ecosystem services. Not least of all thanks to good public relations from GRAIN and other organizations, expulsions of the indigenous population, disregard of human rights or even physical violence against farmers have decreased. However, it is an alarming fact that in recent years, public pension funds have entered the business (Jacob 2015).

The World Bank is pursuing similar projects, e.g., in Mali, where loans to the government are linked with the condition of providing foreign investors with land. In large areas, after the expropriation of resident farmers, no more food is produced for the hungry population, but plants are grown for the production of energy for export to industrialized countries (Oakland Institute 2011, 2016 a, 2016 b).

These acquisitions destroy rural communities and in many cases, also the seed they are caring for. MWith the «Enabling the Business of Agriculture» project (EBA) of the World Bank, which is supported by the Bill and Melinda Gates Foundation as well as by the governments of the USA, United Kingdom,

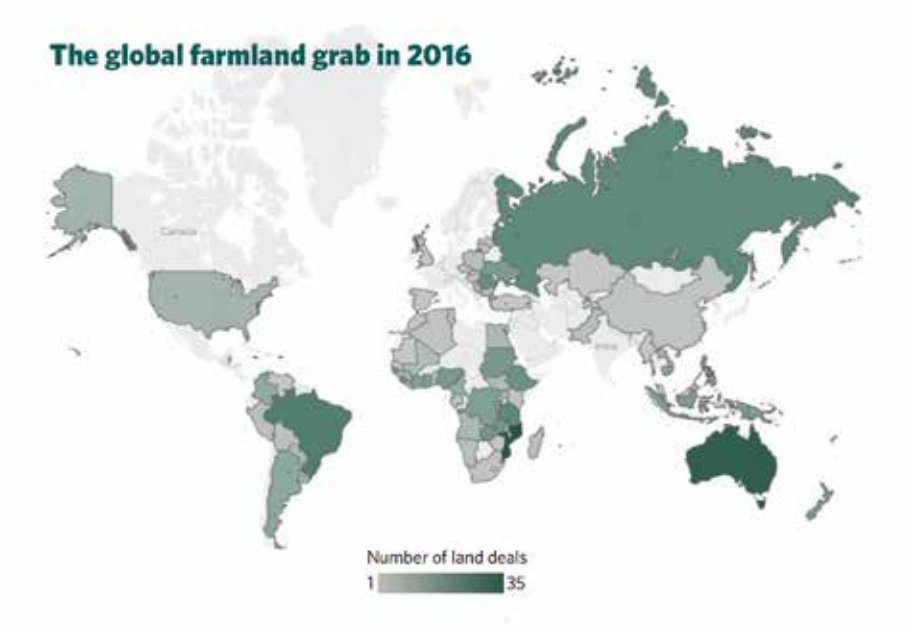


Image 19:
The numbers of land sales or land expropriations in 2016.
From Grain (2016) modified.

Denmark and the Netherlands, a serious change is taking place. Instead of supporting public projects, money from funds and taxpayers is being used to support the creation of agro-industrial opportunities in order to implement agricultural production according to Western views. In order to increase productivity in agriculture with high-performance varieties, synthetic nitrogen fertilizers and plant protection products, it was possible for foreign investors to purchase ten million hectares in various African countries and water rights were ceded to the purchasers.

Other strategies include reducing the traditional range of varieties by taking over local seed breeding and seed trade organizations. In India, for example, Monsanto bought up all Indian cotton seed companies and removed the native varieties off the market. Within a few years, cotton farmers were forced to revert to the company's GM seed. That is why today about 95 percent of cotton production there originates from genetically modified varieties (Shiva 2012, 2016). The debt of the producers is preprogrammed – drought and pest infestation have already led to massive crop failures. This ultimately also resulted in the loss of about 1500 varieties of cotton that were present originally. The free trade treaties that are negotiated in the context of global market liberalization represent another reason for the dwindling of agrobiodiversity. As mentioned, the agreement between the US, Canada and Mexico (NAFTA) has led to a substantial loss of traditional corn varieties in Mexico.

After the abolition of duties and state subsidies that favored American farmers, corn from the USA was sold at a price lower than locally produced corn. As a result, Mexican farmers lost their income and stopped corn production altogether. A large number of traditional varieties were lost. The second example, the Treaty of the COMESA States, has already been described on page 21.

Whichever way you look at it, with profit-orientated activities and the intention of improving the economic situation in the developing countries, neither food security nor agrobiodiversity will be improved. On the contrary, both will be weakened, together with the user communities involved.

Seed regulation

The African Organization for Regional Intellectual Property Rights (ARIPO) comprises 19 countries, 12 of which are among the least developed countries (LDCs). Based on the UPOV model, ARIPO (2016) would like to introduce into its member states variety protection comparable to that in Europe. By contrast, 75 international organizations in the Alliance for Food Sovereignty in Africa (AFSA) promote the rights of farmers in developing countries (AFSA 2014, 2016). They point out that UPOV has been created with the commercialization of agriculture and breeding in industrialized countries in mind, with a focus on genetically and phenotypically uniform cultivars for large monocultures.

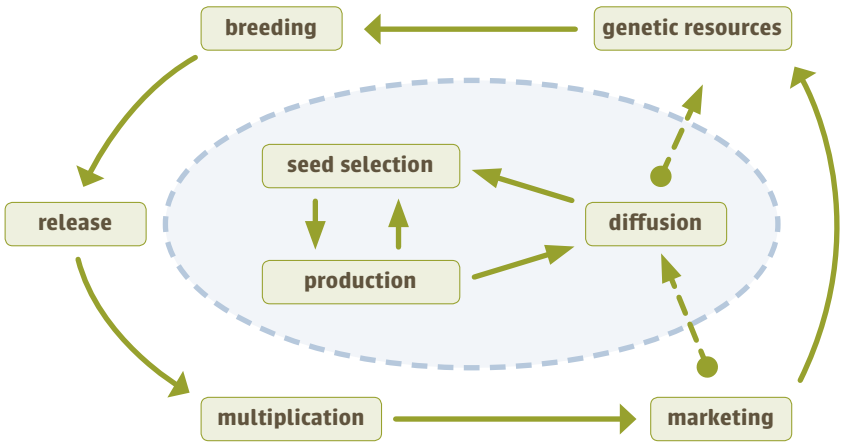


Figure 20:
The relationship between the informal (in the dashed ellipse) and the formal seed sector (box outside the ellipse) is indicated by dashed arrows (Louwaars and de Boef 2012). In the formal sector, created by the division of labor, varieties are mostly bred, registered, protected and marketed by seed organizations and companies. In the informal sector, the production, selection and distribution of varieties by seed exchange without legislation has always been the tradition.

In contrast, 80 to 90 percent of the seed in African countries still consists of an informal seed system, in which traditional varieties, just like modern varieties, are kept for reproduction and exchange on seed markets. There are a number of reasons for this: insufficient access to the market, low funding for the purchase of varieties and few or no suitable varieties of the formal seed sector (Fig. 20).

AFSA also reveals shortcomings in the political and legal situation. ARIPO›s proposal foresees the prohibition of the seed exchange, with a few exceptions, and requires farmers to provide accurate documentation of the varieties used the reproduction. The example of ARIPO can also be applied to agriculture in other developing countries (Bartha and Meienberg 2014, Lieberherr and

Meienberg 2014). Countries that wish to introduce the UPOV seed regulation system or are obliged to do so in the context of lending conditions, are faced with the duty of allowing registered varieties only for trade and production. This will greatly endanger agrobiodiversity as well as the human right to food and its independent production.

This problem is even more severe, since farmers in developing countries often do not know what breeder privilege and its restrictions entail. They also do not know that the varieties that they use could be protected (Netnou-Nkoana et al. 2014). Last but not least, the overall societal development plays a decisive role in these countries. Young people break out of their traditional family and village communities and build their future in the cities. This has far-reaching consequences. In future, fewer people will work in agriculture and the mechanization and intensification of production will increase, including in developing countries. It is a huge challenge to shape agrobiodiversity that is sustainable and without irreversible losses.

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The international seed contracts

Long before the era of free trade agreements and today's land grabbing, the international community, not least at the urging of developing countries, began to negotiate strategies to stop the loss of agrobiodiversity. Initiated by the United Nations, two important treaties have emerged. The first is the **Convention on Biological Diversity (CBD), which, with the Nagoya Protocol (NP),** has now been signed by 190 nations, and has reached its first milestone (CBD 2011). Within the scope of the Convention, the Protocol provides for an implementation strategy to protect the entire diversity of species and varieties; agricultural crops represent only a small part. The NP regulates access to genetic resources through a system (Access Benefit System – ABS) that is facilitated by bilateral agreements for the transfer of plant material (SMTA). ABS and SMTA are intended to guarantee fair and equitable participation of the countries of origin in the profits achieved in the commercialization of their seed and plant material. In most cases, plants or seeds from the countries in the south are brought to those in the north and used for the production of pharmaceutical and cosmetic products. An important component of the NP are proposals to allow donor countries to participate in scientific research and the technical exploitation of their crops. In the case of medicinal plants in particular, the traditional knowledge is indispensable for their usage, and, according to the NP, must be processed only with the consent of the donor countries. The CBD Convention and the NP are progressive in that not only the economic, but also cultural, aesthetic and spiritual values are taken into consideration. However, the Protocol has some weaknesses (Halewood 2015, Pistorius 2016a). Although users from the donor countries are explicitly mentioned as producers and maintainers of agrobiodiversity, the Access Benefit System and other issues

are governed by government agencies, which in turn often violate the rights of the indigenous population. The bilateral system that governs the exchange is cumbersome and lengthy. There is hitherto little balancing of benefits, since their transfer by organizations is not obligatory. For example: with the medicinal plant Madagascar Evergreen and on the basis of traditional medical knowledge, the American pharmaceutical company Eli Lilly generated annual sales of 100 million dollars (Brown 2003). From this substantial turnover, the company has not transferred even one cent. Not unexpectedly, there are two polar positions in the discussion about the ABS. Companies and corporations in the north want access, the indigenous population in the south want benefits.

There are a number of critical arguments regarding seeds for food plants. NGOs and farmers› organizations in developing countries complain that no varieties have been approved for exchange by private breeders and seed conglomerates (Chiarolla and Shand 2013). On the other hand, breeding organizations in Europe and the USA complain about the cost of documenting the traceability of their varieties that came from the south (see e.g. Begemann et al. 2012) and criticize the profit sharing for the sale of new commercial varieties as disproportionate, e.g. when only one property from a species from a developing country (e.g. resistance) has been crossed with an already existing variety.

A second treaty, the **International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)**, was signed in 2004 and has so far (as of 2014) been ratified by 132 parties. It applies to 64 food and forage crops (FAO 2004, Appendix 1) which are considered to be global public resources. Here too, private and legal persons, i.e. breeders and seed companies, do not contribute to the expansion of the pool of varieties, since with the storage of their varieties in gene banks, the variety rights are transferred to those gene banks. Access to varieties and profit sharing is governed by a multilateral system and a standard contract (STMA) which significantly reduces the administrative burden compared to the Nagoya Protocol.
In addition, the payments do not flow to governments, but into a fund that provides support for conservation and breeding projects for all contracting parties – breeding organizations, farmers and non-governmental organizations. This involves not only financial participation, but also sharing of information on varieties, access to and transfer of technologies, as well as «skills training», i.e. training and further education for successful breeding, the provision of research facilities and the support of research projects. Although farmers in developing countries are explicitly recognized for their importance in preserving agrobiodiversity and their rights are mentioned, no direct payments are made to them, even if they have organized themselves into user communities.

In negotiations, criticism of government representatives from the industrial nations and the seed companies is repeatedly expressed because of expenses and costs associated with the agreement. At the same time, they complain that

more varieties and cultivars should be incorporated in the treaty. On the other hand, the authorities from developing countries and NGOs are of the opinion that money from the fund must flow more rapidly and generously, in particular because of variety protection, many varieties from the north will never be available in the south (Halewood 2015, Hammond 2015, 2016, Pistorius 2016 a). A satisfactory solution to these fundamental differences is far off. Unfortunately, this also applies to the acceptance of constructive proposals from NGOs (Pistorius 2016 b), which could be used to reduce substantially the administrative burden. In an interview, François Meienberg of Public Eye (formerly The Berne Declaration) proposes to dispense with elaborate clarifications. Instead of determining from which commercial varieties 0.5 percent of the turnover would have to be paid into the fund, 0.2 percent of the total sales of seed should flow into it.

When the intellectual and creative achievement of the breeder is not recognized by means of variety protection but instead «reified» by the patenting, the public and free access to the genetic resources is blocked.

Seed encompasses characteristics of common pool resources and cultural common property, which also include the knowledge of the development (breeding improvement), the special requirements for cultivation and the qualities for nutrition. These contain the dilemma with which seed and user communities are confronted. As a «natural resource», the danger threatens to be considered and appropriated by all interested parties as freely available – according to Silke Helfrich, «nobody's properties» are created from common property. On the other hand, there is a risk that varieties as «cultural property» will be withheld from the public by exclusive ownership rights. When the intellectual and creative achievement of the breeder is not recognized by means of variety protection but instead «reified» by patenting, public and free access to the genetic resources is blocked.

This problem has various consequences. The first is related to the fact that, for example with ITPGRFA, asymmetries are created. Of the approximately 130 countries that have signed the agreement, only about 20 percent have also passed on information regarding their plant genetic resources (PGRFA) to the FAO. The omission is linked to the fact that seed is also passed on to the non-treaty partner through the treaty. There are therefore hardly any incentives to make varieties and information about their specific characteristics available to third parties who themselves do not store seed in the gene banks. In addition, profit sharing via the Access Benefit Sharing System does not really work: breeders and organizations still pay too little or nothing for varieties they procure. Gene banks can do their jobs only because governments cover the cost of storing, testing and propagating seed, which in 2013 amounted to $20 million.

The International Seed Treaty also prohibits the transfer of varieties directly to third parties after the varieties have been handed over to gene banks. This prevents the practice of the exchanging seed, which has a long tradition in developing countries even beyond political borders. Since no breeder associations or

farmer associations are directly involved in the profits of the Fund, they have to pay the costs of providing their varieties, e.g. for gene banks themselves. There is still no central database that contains knowledge and information regarding varieties. Therefore the «appropriation» of information is possible only to a certain extent. Finally, varieties which run through the ITPGRFA are hardly used by commercial breeding organizations due to concern about possible claims for sharing the costs involved, especially since their use is linked to the obligation to provide accurate documentation on the use of the samples obtained in breeding programs – a considerable amount of work. Usage rules may not be changed by individual partners. Thus, individual agreements between breeders, farmers and gene banks are not possible. Also non-compliance with the usage rules cannot be reported by individual actors. In case of infringement, the ITPGRFA does not provide any sanctions (e.g. limiting access to varieties) even in case of multiple violations of the rules. The Treaty also does not provide any conflict resolutions regarding the SMTA between donors and recipients of seed. This becomes a problem particularly when providers – e.g. breeders or seed companies – refuse to deliver their varieties through the multilateral system (MLS) of the Treaty. Also at the institutional level, e.g. between two nations, because the rules have been set internationally, the MLS cannot be changed or adjusted. Thus, farmer organizations in developing countries are admitted to the negotiations, but their political weight is low.

The free exchange, the sharing of knowledge, the establishment of local seed banks and participatory plant cultivation provide the best conditions for food sovereignty and the maintenance of agrobiodiversity.

It is not surprising that there are doubts about whether international agreements are adequate to protect the rights of farmer communities in developing countries (see, for example, Li et al 2012). These doubts concern not only seed and agriculture, but also any areas of the globalized world: land ownership, natural resources, finance, etc. In a memorandum to the United Nations (UN System Task Team 2013), where new forms of responsibility are envisaged, one reads the statement: «Bilateral, regional and multilateral trade agreements have undermined the political space for developing countries, and are placing great hurdles on the transfer of technologies, while at the same time liberalizing the financial markets has increased their economic vulnerability without necessarily giving them access to stable finances». After an in-depth analysis, the authors concluded that global agreements should have as their objective to establish an inclusive and equitable partnership regarding the global community. «Subcomponents may be e.g., involve increased participation of developing countries in multilateral institutions in order to strengthen their representation and responsibility».

Olivier de Schutter (2009), in his speech to the UN General Assembly, demands that states must implement a seed policy that respects human rights, including the right to food. This includes an extension of the list of varieties in the International Seed Treaty of the FAO, which is subject to the multilateral system of access and benefit sharing (MLS). It is questionable whether and how quickly such adjustments are possible.

Are there alternatives?

A look at a series of initiatives by farmer communities and non-governmental organizations (Seed Freedom 2012) can be helpful. They work autonomously, are careful to develop varieties for the relevant local conditions, and are ready to pass on their varieties to others for free or for moderate prices. Could this agricultural practice not be imitated politically and economically? The free exchange, the sharing of knowledge, the establishment of local seed banks and participatory plant cultivation (for breeding details see Ceccarelli et al. 2009) provide the best conditions for food sovereignty and the maintenance of agrobiodiversity. From numerous initiatives on all continents, some could be selected as prototypes for user communities of common property seed. But before doing that, a few initiatives are presented.

4. Groundbreaking initiatives

Philippines: Masipag

Seed sharing – which is developing into a popular pastime in developed countries, not least as a protest against the increasing restriction of exchange and trade of old varieties – is normal farming practice in developing countries, but often with improved new varieties rather than old ones.

Masipag is an association of village communities and farmers with 30,000 members, 38 NGOs, 20 church development organizations and 15 scientific partner organizations (see www.masipag.org). The organization has nearly 200 experimental farms that cultivate seed for rice and corn, as well as two national and eight regional propagation companies.

Figure 21:
Visit to a pilot farm, Center for Sustainable Agriculture (CSA), India

The community has established some 150 seed banks on pilot farms. There, approximately 2,500 rice varieties, including 1,290 Masipag varieties and 506 native varieties are cultivated by 67 farmer-breeders. The exchange of varieties is widespread, and they are freely available to all interested farmers. Among the rice varieties are some with special characteristics:

- 7 varieties that tolerate flooding
- 17 drought-tolerant varieties
- 19 salt-tolerant varieties
- 23 varieties with resistance to pests and plant diseases

Twelve farmers-breeders take care of the corn varieties. Masipag explicitly opposes the breeding of high-performance varieties which are dependent on artificial fertilizers, water and plant protection products, and strongly promotes organic farming, even if not all farmers follow its principles. Decision-making, planning and implementation are jointly adopted by the members or their representatives. As with research, learning from others is an important part of the initiative. The community works together with scientists who see themselves as consultants and not as leaders in projects with participatory plant breeding (PPB). The operation of Masipag is described with the following characteristics: respect, bottom-up approach, and a comprehensive holistic research agenda. It has been shown that long-term financial support is necessary, as for example the development organization Misereor in Germany has guaranteed for the last 20 years. Masipag does not expect any impetus from the government, but it calls for the abolition of the legal restrictions on the use of local varieties, and requests subsidies to the same extent as those granted to farmers cultivating high yield varieties.

India: Navdanya, CSA and Therubeedi

These organizations in India are three among many there, and together with others form a powerful alliance of farmer organizations and NGOs with an impressive performance record. Founded by Vandana Shiva, **Navdanya** (www.navdanya.org) fights bio-piracy and genetic engineering. It also promotes the rights of local farmers and the maintenance of agrobiodiversity. Navdanya provides advice, lobbies the Indian government on traditional agriculture and provides educational information. The organization does not deny that high-yield varieties of rice are yielding up to 80% more than native cultures. But it also shows at what price – these varieties mature 23 days later than the traditional ones and prevent the cultivation of intercrops before the dry season. They are dependent on irrigation, fertilizer and plant protection products and thus pollute the environment. And lastly, the price of seed is rising to astronomical heights. In 2007, for high-yield varieties, 156 Indian rupees per acre were paid; in 2009 that was already 1,145 – i.e. more than seven times higher! With a Community Biodiversity Register (CBR), Nadvanya is also working to combat losses of varieties and related knowledge, thereby contributing to the

preservation of diverse and sustainable production practices in India. The focus is on the *in situ* preservation of varieties stored in seed banks. In Orissa alone, there are 702 traditional rice varieties, 36 varieties of winter vegetables, 23 varieties of summer vegetables and 41 varieties of vegetables that can be grown during the rainy season. Throughout the country, there are 122 centers with seed banks, where 5 million producers have been trained in seed and nutritional sovereignty and have been taught about the principles of organic farming.

Figure 22:
Yellow board for insect monitoring, Center for Sustainable Agriculture (CSA)

The Centre for Sustainable Agriculture (CSA) is involved in all areas of organic production (http://csa-india.org) from cultivation methods, breeding, training, and processing to lobbying activities (Figs 21 and 22). An open source license was developed here, which differentiates between producers, seed propagators and breeders. It is intended to ensure that seed remains the property of the institution and protects the rights of the institution with an MTA, regulates access to the varieties and prevents misuse.

Therubeedi (Ramprasad and Clements 2016) is an initiative in which a seed bank is set up and which – in addition to the official seed laws – offers a platform where farmers can receive and deliver varieties without the complicated requirements of an official registration. The initiatives receive seed through cultivation, have organized the storage, are developing new varieties and have established a fair ABS system. The latter allows free access to the varieties and prevents freeloaders.

Africa

It is said again and again that in Africa no green revolution has taken place like that in India. This is not true. At least in South Africa there has been a transformation towards monocultures and industrialized production with significant use of water and resources. For many small farmers, change means expropriation and flight. At the same time, production communities have emerged in various countries of Africa, which have continued to preserve

or rediscover traditional farming. The application of biological agricultural practices is accompanied by the cultivation of traditional varieties. As in the Philippines and India, all possibilities for increasing yields are used, but high-yield varieties are not used.

Gene banks, or to put it simply, the careful storage of diverse varieties, is maintained in all communities. Experts of many NGOs have helped to improve them by building the infrastructure, including houses, protection from pests and cooling systems for storage. These organizations support the farmers in projects with PPB, in the implementation of markets where seeds are exchanged, and in the search for new suitable varieties which are tested in different communities for agronomic properties, quality and yield. Important work also concerns the collection of varieties in local seed banks, with which an attempt is being made to obtain seed that farmers have ceased to cultivate for whatever reasons. Central is the exchange of experience and basic introductions to the methods of cross-breeding and selection. Finally, in some countries, NGOs are politically committed to avert changes to the seed laws that restrict or ban the cultivation of traditional cultures.

Africa RISING and **BéDé**

The umbrella organization Research in the Sustainable Intensification for Next Generation (RISING) (www.africa-rising.net) initiates, supports and monitors projects in East and West Africa with various partners (governmental and non-governmental organizations). Also, breeding projects are among the numerous activities to improve the livelihoods of the village communities. The cultivation of different varieties, e.g. millet, corn and sorghum, meets with great approval among farmers. They are trained in the selection of the best varieties and also with incidental crossings. Hybrid breeding projects for self-pollinated cultures are also successfully carried out. As parent lines serve unrelated local varieties. Additional yields of around 40 percent, and often even far more in the case of sorghum and corn show their impressive success (Fig. 23). The farmers learn to improve soil fertility, and are introduced in participatory breeding projects to the principles of selection and plant breeding.

BéDé (www.bede-asso.org/) is active in West Africa. The organization, together with regional partner organizations, supports agricultural communities. It focuses on information events on seed rights and seed laws, assistance in carrying out decentralized projects for the selection and breeding of corn, millet and sorghum. Comparisons of varieties have shown that the traditional farmer varieties are superior to cultivated varieties, especially under variable conditions. The organization is also committed to the implementation of seed markets and to the construction of buildings for safe storage of seed.

Figure 23:
A farmer trained by RISING in Tanzania shows her colleagues the success of corn cultivation. Thanks to better fertilization and the crossing of two rather homogeneous local cultivars ("hybrid cultivation") the yield rose from 0.2 to 4 tons.
Image: Ahazi Mkoma/ICRAF

5. Seed as common property with user communities

In an in-depth analysis of the ITPGRFA, Halewood (2013) outlines a number of options for how the International Seed Treaty could be improved (Table 5). They are helpful and their implementation could make the Treaty more transparent and fair.

Table 5:
Proposal of Michael Halewood for reform of multilateral systems

International organizations such as the CGIAR Centers, national gene banks and other ITPGRFA member institutions stop deliveries to non-member countries.
All member countries are required to make contributions to the MLS before they have access to the varieties or to contributions from the Fund. Contributions include information on seed stored in national gene banks, the adoption of obligations to maintain, propagate, characterize and evaluate varieties, taking into account the technical and financial capacities of donor countries.
All natural and legal persons are obliged to make proposals for cost participation before they are given access to the varieties.
The costs of voluntary seed storage in gene banks must be adequately compensated. For this purpose, e.g. money from the fund can be used.
Commercial users are obliged to make prepayments, in return they can dispense with the documentation on the use of the obtained varieties.
Users of varieties must be given the opportunity to participate in the control of the rules, to report abuses and to decide on the nature and amount of sanctions.

As sensible and bold these considerations are, the negotiations for their implementation will be lengthy.

For this reason, we present a proposal to supplement the two treaties – CBD and ITPGRFA – with a third system: the establishment of local user communities based on the example of Ostrom. We are convinced that many agricultural communities on all continents, consciously or unconsciously, follow rules that partially or completely apply the design principles elaborated by Ostrom and colleagues. What is missing is only their international, legal recognition. For advocates of centralized procedures as applied in the international seed treaties, the decentralized model represents a major challenge and even a threat. Due to the fact that it is not just another form of law, this model requires a change of consciousness. Higher priority is given to the common good and leaves the usage and rules of use completely in the hands of the farmer communities. The economics of abundance (Hoeschele 2010) reduces the gap between rich and poor. International legal regulations are thus changing from comprehensive control to trustworthy provision. The sustainable livelihoods of farmers in developing countries are given a higher priority than national, international and private interests. Common resources and their user communities have grown historically, and their advantages over private property or state ownership are impressively documented (Ostrom 1999). Establishing seed as common property requires three steps. The first step involves the transparent description of user communities with design principles that ensure a sustainable existence. In the second step, it is a matter of positioning the user communities as additional stakeholders on equal footing with the national and international seed laws and treaties. And in a third step, funding for conservation and breeding work must be developed, which differentiates and distributes existing resources directly and equitably to the user communities.

For advocates of centralized procedures, as applied in the international seed treaties, decentralized models represent a major challenge and even a threat.

6. The description of local and regional seed user communities

From a multitude of projects that on all continents successfully cultivate, propagate and develop seed, a number of «prototypes» are selected and described (Table 6). The design principles are intended to decide on the intensity of breeding, as well as the exchange modalities and the storage of seed.
The development of prototypes, the first step towards the characterization of user communities, will not present any great difficulties. The countless NGOs working on all continents provide the necessary know-how. They are familiar with the structures and conditions of the farmers. They know the importance of the diversity of crops and varieties for the food security of the population and they know the importance of seed exchange and seed markets. They help the producers to build seed banks and with the design and organization of participatory plant breeding projects.

Table 6:
The design principles of sustainable user communities for seed as common property

1. Clearly defined limits User communities shall draw up a list of their members and the crops and varieties they use.
2. Appropriation and provision They organize a seed bank and undertake to store and document their existing varieties and new developments. If this task is delegated to individual members, there will be fair compensation.
3. Collective decisions All users meet on a regular basis to decide on the rules of use and discuss necessary changes. They decide who can obtain varieties for free, who will be obliged to pay (and how much) or how to support the community or the seed bank. The income from any sales is managed by the user community.
4. Monitoring The community shall determine how compliance with the rules of use is controlled and, where appropriate, how to hand over the control to one or more trusted persons.
5. Sanctions The user community has the right to impose a range of sanctions against users who violate the rules (depending on the gravity and context of the infringement, but also on their financial situation).
6. Conflict resolution mechanisms Conflicts between users of a community shall be discussed and resolved promptly within the community or by a trusted person appointed by the community.
7. User communities The user community is recognized in national and international seed legislation with its rights and obligations.
8. Embedded companies Depending on the situation, the cooperation with other user communities is described and regulated, especially in the development of new varieties or in the context of participatory plant breeding projects.

All these skills are indispensable in order to make, together with the user communities, the eight design principles realistic and effective. In addition, they have recognized the importance of more powerful varieties and are familiar with the interfaces between the informal and formal seed sector. With representatives of user groups, together with NGOs and peers from the CBD and ITPGRFA, the prototype communities can subsequently develop the relationships, similarities and differences of the prototypes for further political implementation.

With this comprehensive panel of experts, all stakeholders are involved right from the start, can put their knowledge into practice and are familiar with the design principles. It will be essential to record the rules for when and under what conditions these principles can be further refined and adapted.

7. The legal basis

The second step of anchoring user communities with their common property into existing national and international contracts, laws etc. is demanding, challenging and lengthy.

Land rights, variety rights, breeder rights

The goals are ambitious, because it is not only about seeds and varieties. First and foremost, the user communities must be entitled to own their land as a property or to manage it in leasehold through long-term contracts. Anyone who does not know how long he or she may stay, will not invest in seed development or soil fertility.

Because the pool of varieties is continually being expanded with seeds from other communities, with seed from exchange markets or through the purchase of varieties from the formal sector (e.g. breeding organizations), the free reproduction of these varieties must be legally secured. Finally, the communities must also have the right, e.g. in the framework of participatory breeding projects, to improve their own varieties by crossing with purchased ones and to pass them on to third parties or, where appropriate, to sell them.

These legal certainties are an unquestioned matter of course in industrialized countries, and should also become so in developing countries.

8. The framework

First and foremost, the user communities must have the right to view their land as a property or to manage it in leasehold through long-term contracts.

Ostrom has shown with some examples that user communities can make use of a common pool resource sustainably only if their organizational form has been recognized by a higher authority. The prototypes are therefore dependent on recognition first at local and then at national level. This procedure is necessary for two reasons. Firstly, building confidence is easier under manageable social and local conditions. Secondly, the international seed contracts are subordinated to national legislation. The next step is to examine the possibility of establishing the country-specific recognition of user communities as a third form of efforts to maintain agrobiodiversity internationally. Experts in contract, seed and policy law involved in the conception of the CBD and IT-PGRFA, help to formulate laws and rights that guarantee property and access

to seed, comparable to the existing seed laws in Europe. It is conceivable that, in addition to ex situ gene banks, in situ conservation communities also make their varieties available to third parties for adequate compensation. A conservative strategy under the existing laws, regulations and treaties could lead to a minimum recognition of user communities. On the other hand, the progressive strategy develops proposals for how the rights of the user communities should be optimally designed. In this case, adaptations, i.e. changes in existing conventions, laws and regulations, would have to be taken into account.

Fears that the introduction of a new seed management system will further increase administrative burdens are unfounded. While user communities manage their users' rights, their compliance and the sanctions for infringements themselves, the burden of a centralized authority would be reduced by decentralization. In addition, the rules would better fit the different social, societal and cultural contexts, and the necessary adjustments for their change could be made more quickly.

9. Access to varieties and profit sharing (ABS)

There are some benchmarks for the success of decentralized user communities that are committed to the common good. The first benchmark measures whether or not the loss of the diversity of crops and varieties can be stopped. This will be identifiable shortly after the communities have been approved. The second benchmark relates to food sovereignty, which will rapidly improve with transparent agreements on soil, variety and breeding rights.
The third benchmark encompasses all aspects of access and benefit sharing. The access to seed and varieties is unlikely to change significantly, on the contrary, it might be improved as soon as user communities submit to existing databases information regarding the cultivars that they grow . The availability of these varieties is guaranteed. However, the flow of possible payments is redirected by the authorities or a seed fund directly to the user communities and quickly arrives – as recommended by Halewood (2013) – at the communities through fair negotiations and prepayments.

Organic farming and the farmer communities in developing countries have something in common: a production that conserves natural resources.

More important, is that decentralized settling of benefit sharing, even more strongly than before, will not only be done in monetary terms. Depending on the needs of the users, a reasonable compensation for access to natural or cultural resources can be provided in the form of training, breeding projects, improvements in the storage and management of seed or in the form of the development of the community infrastructure. Perhaps the most important contribution to preserving agrobiodiversity and food security may consist of the authorization to access seeds and varieties from the formal sector, i.e. from breeding organizations in the industrialized countries. The necessary development of traditional vegetables and agricultural crops would be free

of charge and without fear of court action. These benchmarks are easy to evaluate, and, as above, flaws can be corrected or improvements carried out quickly. The financing will not significantly affect the benefit sharing of the two international treaties.

10. User communities and their contribution to ecosystems

Organic farming and the farmer communities in developing countries have something in common: both have productions that preserve natural resources. Ecological production is a conscious decision in Europe and the USA; in developing countries, small farmers cannot afford the purchase of fertilizers, herbicides and pesticides. Their methods are often referred to as «organic by neglect». This description is misleading, since not only the «International Assessment of Agricultural Knowledge, Science and Technology for Development» (IAASTD), but also the FAO (2014) emphasize that input-intensive production is not an option for solving the world hunger problem. The increase in productivity must be achieved through sustained intensification, i.e. through sustainable management of natural resources and ecosystems.

Advantages of organic production in developing countries are striking (Pretty et al. 2006). 2.6 million farms and a total of 37 million hectares in 58 poor countries were converted to ecological production. Two years later, yields of farms that had completely dispensed with pesticides rose on average by 80 percent. The reduction of pesticides by approximately 70 percent still resulted in increased yields of 42 percent. These increases were related to improved soil structure and thus less erosion as well as to a significantly improved water holding capacity. These characteristics are of crucial importance in regions with extremely rainy periods and long periods of drought, since, compared with conventional farming methods, they help to extend the duration of vegetation for three weeks. The massive reduction in plant protection products improved the water quality and thus the health of the population. The consequences for soil fertility from the conversion were significant. On average, 350 kilograms of carbon were sequestered as humus per year and hectare, and therefore extracted from the atmosphere. Model calculations show that, if 25 percent of the world›s agricultural land would be converted organic, around 0.1 gigatons of carbon would be sequestered annually from the atmosphere. This means that regarding climate protection certificates developing countries gain in two ways. According to plans for EU emissions trading, 20 billion euros could be earmarked each year for climate change projects in developing countries (Robert 2015). However, the price of 5 – 7 euros per ton (Jakob 2015) would have to increase to more than 30 euros, an increase experts believe to be realistic and necessary. The working group around Jules Pretty also showed that the agricultural production of the traditional farmers could be increased 2 – to 3-fold within less than ten years (Pretty et al. 2012).!

Balla Berthe during the Fadda-harvast (Image: Eva Weltzien)

The reasons why can be read like a confirmation of the importance of user communities: scientists and farmers combine livestock farming and agriculture with agro-ecology and agronomic management. This also includes more efficient seed; the establishment of new social structures which strengthen the trust between farmers and authorities; the improvement of farmer knowledge and the establishment of agricultural colleges; the use of modern communications technologies; the engagement of the private sector for supplying goods and services; the focus on the needs of women regarding education and development of agricultural techniques; the access to microcredit and rural banking institutions; and the provision of public services for the support of agriculture.

Eco by neglect becomes Eco by demand!

As in the case of ecological breeding in Europe, it is also necessary to consider how farmers – when they produce ecologically – can directly participate in the returns of ecosystem services. There is room for user communities even in this internationally regulated market, since organic farming not only produces food, but also provides people and regions with clean drinking water, clean air and healthy soils with an improved water supply. Eco by neglect becomes eco by demand!

11. Outlook

Securing seed as a common property with user communities which determine their rights and duties autonomously, is a major challenge. First of all, it requires a paradigm shift in social, political and legal understanding. The rules that were drafted by the state, the authorities or national and international organizations for the protection of the rights of use, must be supplemented. For this, it is necessary to rewrite the roles of politicians and authorities (Weston and Bollier 2011, Helfrich and Bollier 2012). They must refrain from the view that the protection of (agro)biodiversity can be controlled by their treaties. Instead, they have to function as midwives to and supporters of user communities in order to meet more effectively the objectives of food security and sovereignty, preservation of agrobiodiversity and ecosystems.

The implementation of this is dependent on ideological and material assistance from governmental and non-governmental organizations that are involved in the many projects in these countries. It would therefore not be necessary to provide new material and human resources, but merely require a partial shift in activities. In addition, it must be acknowledged that the farmer communities make large contributions to the general public, which can also be valued on a monetary basis. There are integrated assessment systems that include, beside the yields of production, also the diversity of the crops and varieties used and the indirect contribution of ecological production as well as the improvement of drinking water and air quality. All of them result in improved health and thus in a lower cost for healthcare. The improvement of soil fertility through sound ecological farming practice is making a substantial contribution to mitigating the greenhouse effect. An integral assessment of the achievements of the farmer communities with appropriate financial compensation and with the prospect of participating directly, create incentives and signals for imitation.

The rules that were drafted by the state, the authorities or national and international organizations for the protection of the rights of use, must be supplemented. For this, it is necessary to rewrite the roles of politics and the authorities.

Regarding the human rights concerning a clean and healthy environment, Weston and Bollier (2011) have set out a detailed path of how user communities should be structured and the task which the legal system and politics should carry out. They emphasize – as has been done here – that the design of the internal principles and the framework for the development and management of common pool resources (community property) is the essential task of the user communities themselves. The principles for dealing with resources, common property friendly laws, institutions and procedures have to be developed together with the authorities, users and representatives of the free market economy. It should be emphasized once again that the shaping of the common resource must remain in the hands of the communities, while they are enabled by authorities, politics and civil society. Enabling requires respect, mutual trust, willingness to cooperate and a fair division of costs and profits. ■

Sowing the future! Action in Italy, Fattoria di Vaira, Petacciato, October 2012

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Seed is common property

This study describes ways to maintain and sustain the development of seed as a common good. It describes which requirements for plant cultivation oriented to the community must be met in Europe, and under what conditions the diversity of varieties in the developing countries can be protected against further erosion. The fact that one and the same seed package contains an economic, a legal and a cultural property, is the starting point of the work. These three properties and the transitions between them are analyzed in a differentiated way, and concrete solutions for practical action are described.

The study includes four parts. Part A deals with the current situation of agriculture and the cultivation of vegetables on a global scale. Part B examines how the commons or common pool resources must be organized and managed so that they can be maintained over long periods of time. Part C describes ecological breeding in Europe, which has its beginnings in the biodynamic movement and aims to contribute to sustainable agriculture, biodiversity and nutritional sovereignty. Part D analyzes the situation of plant cultivation in developing countries.

Open day at the nursery
GZPK, Feldbach, 2015