



Enabling Diversity

Ways to finance organic plant breeding



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1 Introduction

For many consumers today, organic food is commonplace. Almost everywhere in the European Union (EU), organic food can be obtained not only from specialist retailers but also from discounters (supermarkets) and, since more recently, from community-supported agriculture (CSA) groups. The organic market is growing rapidly, and this trend is expected to continue.

With the expansion of organic farming, the demand for suitable organic seeds and vegetative propagation material has also grown. A wide range of locally adapted crop species and varieties is needed to fully utilise the potential of organic farming in different areas. Especially genetic diversity within and between species is key for adaptation to changing environmental conditions. So far, much of the seed and vegetative propagation material used in organic farming is grown organically but not bred organically. Thus, it lacks specific values intrinsic for organic breeds.

A shortage of funds for organic plant breeding appears to be a main constraint to increase the few and laudable efforts of the current organic breeders to satisfy the demand for organically grown and bred varieties and vegetative propagation material.

Plant breeders, farmers and other actors in the organic food supply chain are increasingly asking why funding is insufficient and how this problem can be solved.

Agrecol, a non-profit association of about 60 professionals in agriculture and rural development that has been supporting organic and sustainable agriculture in developing countries for more than three decades, has been working on this issue for several years. Initial results were published in 2015¹. Since then, the urgency to find answers has become even greater. In 2019, Agrecol held an interdisciplinary workshop together with plant breeders, seed experts and commons scientists². Focusing on the European seed market, the group looked for new financing strategies. This paper was stimulated by and builds upon the workshop discussions. It analyses shortcomings in conventional plant breeding, discusses the need for alternatives and proposes viable options.

2 Plant breeding in transition

2.1 Conventional plant breeding in a dilemma

Our crops are the result of a selection process of sometimes over thousands of years, an evolution directed by humans³ – referring to both men and women⁴. Scientific plant breeding emerged only in the second half of the 19th century⁵. At that time, crop farmers, for instance in Germany, were interested in new varieties that would allow them to make better use of their investments in soil fertility through an improved three-year crop rotation. In many places and in a relatively short period, first scientific-oriented breeding initiatives emerged. Soon afterwards, the foundations were laid to regulate the seed market⁶. Seed quality control centres were established, a procedure for variety recognition and protection was developed, and a variety registry was put in place.

These regulatory processes had an enormous impact on plant breeding and agriculture. With the new varieties, the yield of many crops could be increased, in some cases many times over. Resistance to diseases, which had sometimes led to total crop failure, could be greatly improved. Plant breeding has been the greatest contributor to intensification of agriculture⁷, clearly ahead of the contribution of mineral fertilisers and chemical plant protection.

At the same time, the regulation of seed markets triggered a process of privatising seed. Privatisation contributed greatly to the disappearance of economically less important or only locally important crops and varieties and thus to a major loss of biological diversity. Privatisation led to market consolidation of the seed sector⁸. At the beginning, it was the farmers – either individually or in cooperatives – who started to breed and sell improved seed. Soon, these initiatives became specialised plant-breeding companies. A new economic sector of mainly small and medium-sized enterprises (SMEs) developed. Then, in the 1970s, international chemical companies discovered that plant breeding is a highly

profitable business. This led them to acquire seed companies, setting in motion a process of market concentration⁹. Today, only three international chemical companies¹⁰ control more than 60% of the global commercial seed market, a market concentration of unprecedented scale that has meanwhile reached monopoly-like proportions¹¹.

Essentially, the funding of private plant breeding is based on royalties from intellectual property rights (IPRs) such as plant varietal protection and patents^{12,13}. In the IPR-based funding system, varieties are most profitable when grown on a large scale. Consequently, this business model promotes standardised and uniform agricultural production and contributes to reducing plant genetic diversity. The formation of monopolies also creates growing dependence of seed users and society as a whole on just a few companies. All this has reduced agrobiodiversity tremendously and puts the sustainability of agriculture and food at risk.

2.2 Mismatch between supply and demand

The conventional seed market offers an impressive number of varieties for our main crops, but most of them are highly homogeneous: they do not differ much from one another. Genetic uniformity prevails as a result of the one-sided focus in breeding on a limited number of characteristics such as high yield, uniform maturity or short stalks¹⁴. Furthermore, uniformity is legally required to register and protect a variety as being private and exclusive as demanded by the Plant Variety Protection Act. Therefore, IPR-based plant breeding cannot provide the plant genetic diversity that our planet needs. Only a few crops are subjected to intensive breeding efforts, resulting in fairly homogeneous high-performing varieties for large-scale distribution.

However, uniformity in crop production is exactly the opposite of what is needed to meet the main challenges in today's agriculture^{15,16}. Adapting cropping systems to climate change, generating food security for an expected 11 billion people¹⁷ and transforming production systems from a chemical-based to an organic way of farming are huge tasks, in which plant breeding plays a vital role.

A rich biodiversity is the basis for resilience and adaptability of cropping systems. It is also necessary to preserve cultural landscapes and their ecosystem services. Varied crop rotations, the cultivation of many different crops and the use of productive and sufficiently heterogeneous varieties are main elements to optimise cropping systems ecologically. Therefore, suitable varieties need to be generated and maintained by plant breeding¹⁸. However, the private seed sector is structured and financed in such a way that it will not be able to provide this crucial biodiversity. Alternatives to conventional plant breeding must be found.

2.3 Organic plant breeding – a novelty

As an alternative to conventional plant breeding, organic plant breeding has emerged as a novelty in the seed market. Organic plant breeding is defined mainly by the breeding technologies that can be used¹⁹. The genome is respected in a way that physical insertion, deletions or rearrangements of the genome are not allowed, the plant cell is respected as an indivisible functional entity, and methods of genetic engineering are excluded²⁰. Furthermore, a key objective is to sustain and increase genetic diversity, that is, to enhance agricultural biodiversity. Based on these definitions, a private standard and certification system for organic plant breeding has recently been established²¹. It is clearly spelled out that "... varieties and their characteristics may not be patented or given exclusive rights, so that they are freely available to every breeder and grower"²².

Organic plant breeding was founded by pioneers mainly from the bio-dynamic agricultural movement. They sought crop varieties that are better suited for organic agriculture. Today, most of these breeding initiatives take place in Austria, Germany, Switzerland and the Netherlands. Within the past 25 years, the organic sector recorded considerable growth, but the development of organic plant breeding and seed production has not kept up with the increase in area under organic crops – now about 10% of the

total cultivated area in the EU²³. Therefore, most varieties used in organic agriculture are still coming from conventional plant breeders, even if seed is multiplied organically.

Organic plant breeding is still a small niche in the seed sector. Its financing volume has been growing continuously by about 10% per year and, currently, a total funding volume of about 4–5 million Euro per year can be estimated for the above-mentioned countries²⁴. On one hand, this is a remarkable success; on the other, it is far from satisfying the current needs of organic plant breeding, estimated to be at least 100 million Euro per year²⁵. Lack of financial resources is the key constraint to an expansion of organic plant breeding.

Most of the existing funding for breeding comes from donations and a small part from seed sales. Royalties from plant varietal protection (PVP) – the classical source of funding for plant breeding in Europe – contribute little or nothing to financing organic breeding. A survey among organic cereal breeders revealed that foundations alone contributed 35–81%, whereas payments from PVP contributed 0–12% (average 8%) to cover the costs for breeding²⁶. There are several reasons why IPR-based funding contributes so little. Firstly, the area cropped with organic cultivars is too small to generate sufficient income from royalties. Secondly, large-scale expansion of one cultivar contradicts the need for diversity in organic cropping systems. Thirdly, most organic plant breeders consider their cultivars to be a commons and reject the idea of claiming IPRs. This is also reflected in the standards of Bioverita Rules that explicitly exclude patents or exclusive rights in organic plant breeding²⁷.

Claiming IPRs and creating plant genetic diversity contradict each other. As the latter is a main goal in organic plant breeding, it can be concluded that alternatives to the IPR-based financing model have to be found.

3 Seed as a commons

3.1 “Commoning” as an alternative economy

The commons is back. For some years now, a renaissance of commoning – social cooperation in use of commons – can be observed, shaping our social discourse and practice as citizens. Commons research has meanwhile become established as a new scientific discipline. Particularly groundbreaking was the work of Elinor Ostrom. In numerous case studies, she and her team investigated how social groups worldwide manage their natural resources – land, forests, pastures, fishing grounds – collaboratively and as a common good. Ostrom refuted Hardin's thesis of the “tragedy of the commons”²⁸, which was based on the assumption of inevitable overuse and destruction of a common good by single individuals. On the contrary, she provided evidence that an economy based on commons can be very sustainable, as long as clear rules have been agreed. In essence, she postulated seven design principles for successful management of commons²⁹. For this achievement, she was awarded the Nobel Prize in Economic Sciences.

Also in plant breeding, the concept of the commons is gaining importance: organic plant breeders are putting their work in the framework of non-profit organisations that also act as variety owners³⁰. The vegetable breeders of the German *Kultursaat* association go one step further. They completely forego PVP³¹ and release their new varieties freely available for everybody – but also with no rules about use and no protection against renewed private appropriation of derivatives.

3.2 Open source to prevent appropriation

There are two key principles in managing commons. They must be protected if they are to be maintained, and there are no commons without commoning: rules and regulations must be made by and applied by the people concerned. The open-source principle was developed on this basis. Computer scientists in the 1980s created the open-source licence for software, which led to various Creative Commons Licences for manifold products under copyright law.

With respect to open-source seed, there are basically three rules:

- Everyone is free to use, multiply, develop and breed the seed.
- No one may apply IPRs such as patents or variety protection to the seed and its further developments.
- All recipients of open-source seed transfer the same rights and obligations to future users of the seed and its further developments. This obligation, referred to as the “copyleft clause”, secures that the seed and all its derivatives through subsequent plant breeding remains open source and thus a commons.

Following these rules, there are thus far two approaches to support breeders and seed producers to manage seed as a commons. The Open Source Seed Initiative (OSSI) in the USA pursues an ethical approach using a pledge³². OpenSourceSeeds hosted by Agrecol in Germany and, since recently, also Bioleft in Argentina use a licence^{33,34} that can be legally enforced. Various other initiatives are underway³⁵.

Open-source seed closes a gap in the current practice of organic plant breeding. So far, most new varieties have been released without any protection, a practice that can be referred to as “open-access” and carries the risk of future appropriation by the private sector.

In summary, the open-source strategy will enable the development of a seed sector based on managing seed as a commons to ensure free access to valuable breeding material for all breeders who reject the IPR approach. An open-source strategy is a first step towards the re-emergence of SMEs in plant breeding and the urgently needed diversity in crop plants and their varieties. And for organic seed, the commons attribute is essential.

4 New funding strategies

It is thus evident that financing plant breeding through IPRs and with royalties is not an appropriate strategy for the organic sector, mainly because IPRs and plant genetic diversity are mutually exclusive. We in the Agrecol Association therefore sought funding strategies that renounce the use of IPRs.

In the search for alternatives, we looked at the wider picture, because organic seed is more than just an input for agricultural production. It is essential to maintain landscapes and their ecosystem services, as well as to maintain and create genetic diversity and, with this, the capacity to adapt to climate change. Many of these services go beyond immediate requirements for agriculture and bring benefits for society as a whole. So far, the breeding costs for a variety have been carried by the direct users only: the farmers. Following the logic to involve also society as a whole, the farmers would not be left alone but rather would contribute an appropriate share of the total costs. In view of the benefits to the wider society, it is justified that it be addressed through the market, state support, commoning in civil society or a combination of these strategies. Actors in the food industry along the entire value chain of organic products up to and including the consumers could participate in financing the breeding.

Government support can be justified in that breeding can be seen as a public service to maintain an essential infrastructure, because plant breeding contributes to maintaining landscapes and their ecosystem services. Government support for organic breeding – and not only for plant-breeding research – would require legal changes at EU level. In concrete terms, it could be ensured that the legislative package for implementing the European Green Deal provides exceptions for organic plant breeding. These should allow EU Member States to provide public money for organic plant breeding as a public good without being accused by the private sector that this distorts competition. It is an important task of civil society to push this issue forward.

Generally, there is no silver bullet for the financing of organic plant breeding. Instead, a comprehensive strategy would be composed of a spectrum of different financing models. Such a strategy requires a

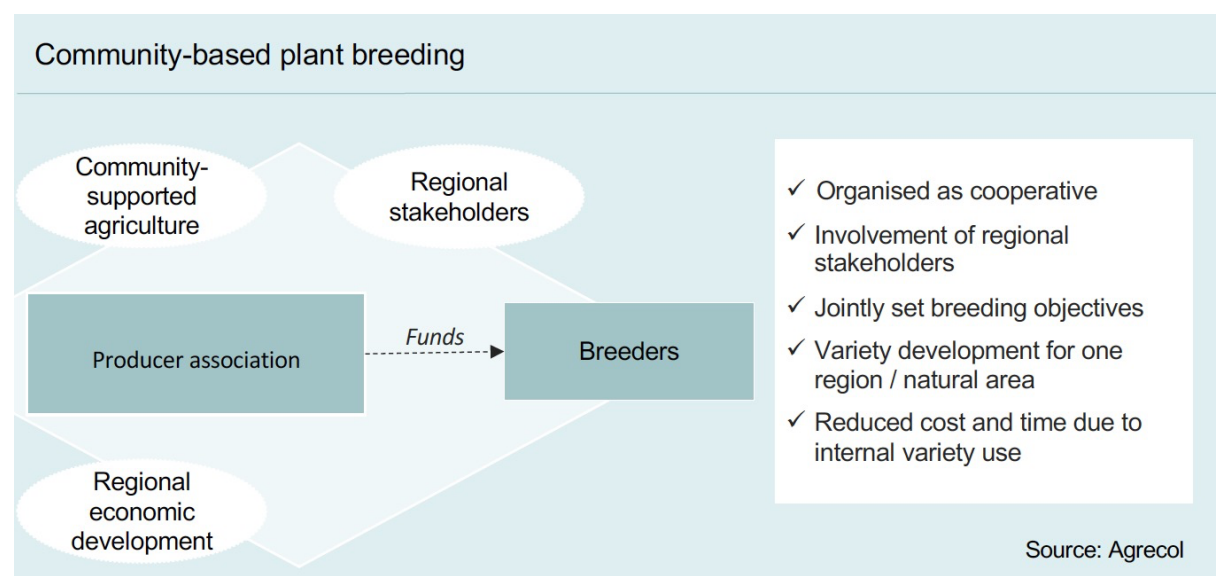
coordination mechanism. It is advisable to set up several funds, similar to the seed fund of the Future Foundation for Agriculture³⁶. Several funds with different funding models, e.g. with respect to prioritised breeding objectives, would offer the possibility of competition between the funds. In the next section, we present innovative ideas for multiple ways in which they could contribute to organic plant breeding.

4.1 Community-based plant breeding

Community-based plant breeding follows a strategy in which several farms in one natural region (landscape unit) operate and finance plant breeding collectively, with the objective to develop locally adapted varieties. Today, so-called farmers' varieties or regional varieties would be a promising way to give value to site-specific characteristics. In combination with a certain degree of heterogeneity of cultivars, a higher level of resilience to weather extremes could be reached. First results from breeding with organic populations go in this direction.

Community-based plant breeding requires new forms of organisation and financing. Essentially, two forms are conceivable:

- Several crop-farming and horticultural businesses operating under similar agroecological conditions join forces in managing a joint breeding programme. Together, they finance a professional plant breeder or give the task to a breeding company.
- Associations of CSA groups practise regional plant breeding. With this option, producers and consumers finance the breeding jointly. It is possible that several CSA groups cooperate and share costs among the combined members.



The commissioning parties for plant breeding are either producer communities or producer-consumer communities. For both, the legal entity could be a cooperative. The cooperative could share the costs according to the size of the different member organisations. It is also conceivable to apply the CSA-proven tool of a bidding round for a breeding programme. In this case, the expected costs are made known in advance. All participants then offer the amount they are willing to contribute and according to their own judgement. The procedure of bidding is repeated until sufficient funds are collected to cover the budget. If the difference between the funds offered and the planned budget remains high, the proposed breeding programme can be discussed, reconsidered and further adapted.

Another advantage of community-based plant breeding is that the time periods for breeding can be shortened and costs saved: for internal use within the community, cultivars can be used earlier and

with less homogeneity and stability than required for official registration. Indeed, official testing and registration could be foregone, saving both time and costs. In case an internally used cultivar proves to be particularly successful and shows potential for seed production and commercial use, its breeding process could still be completed with respect to meeting the officially required DUS (Distinctness, Uniformity, Stability) criteria and the cultivar could be officially registered with the Federal Plant Variety Office.

Next to financing, community-based plant breeding enables cooperation between all stakeholders, similar to the concept of participatory plant breeding. The breeders' objectives, the farmers' and gardeners' expectations, and the consumers' wishes can be more closely aligned. Supply and demand can be matched more effectively.

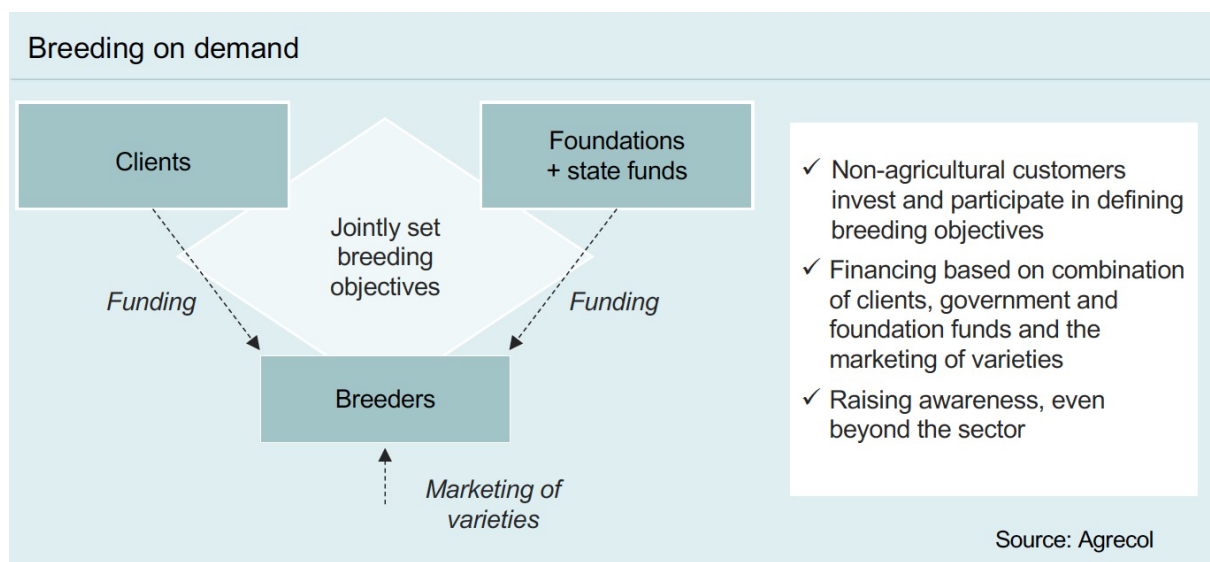
So far, there is little experience with community-based plant breeding. However, it has the great advantage that this approach to breeding can be started on a small scale, for example, with only one crop, such as developing a locally improved wheat population.

4.2 Breeding on demand

Breeding on demand is oriented towards the ideas and wishes of the clients, who partly or completely cover the costs for breeding. The breeders and clients jointly design the breeding programme and set the breeding objectives.

When plant breeding is offered on demand, new stakeholders can be involved. Anyone who expects this to benefit their company or area of responsibility can be considered a client, for example:

- A supermarket that wants to offer special regional products
- A waterworks that depends on organic production for treating its drinking water; promoting organic varieties can help keep pesticide and nitrate levels low in the long term
- A company that wants to make a stronger commitment to sustainability by investing in environmentally friendly projects, e.g. corporate social responsibility.



In Switzerland, a group of companies is moving towards contract research, focusing on sunflowers. Since sunflowers for producing oleic acid to use in cosmetics are currently available only as hybrids, the group commissioned a breeder to develop an open-pollinating variety. The group is committed to financing this task over a long term, which allows breeders to plan their budgets better. This is one example of a largely untapped potential.

Breeding on demand enables financing of breeding of niche crops in addition to crop varieties suitable for the market and mass production. Generally, it can help make breeding more oriented to needs and can enhance the diversity of varieties. In addition, and as a service-based approach, it offers great potential for raising awareness about plant breeding beyond the agricultural sector.

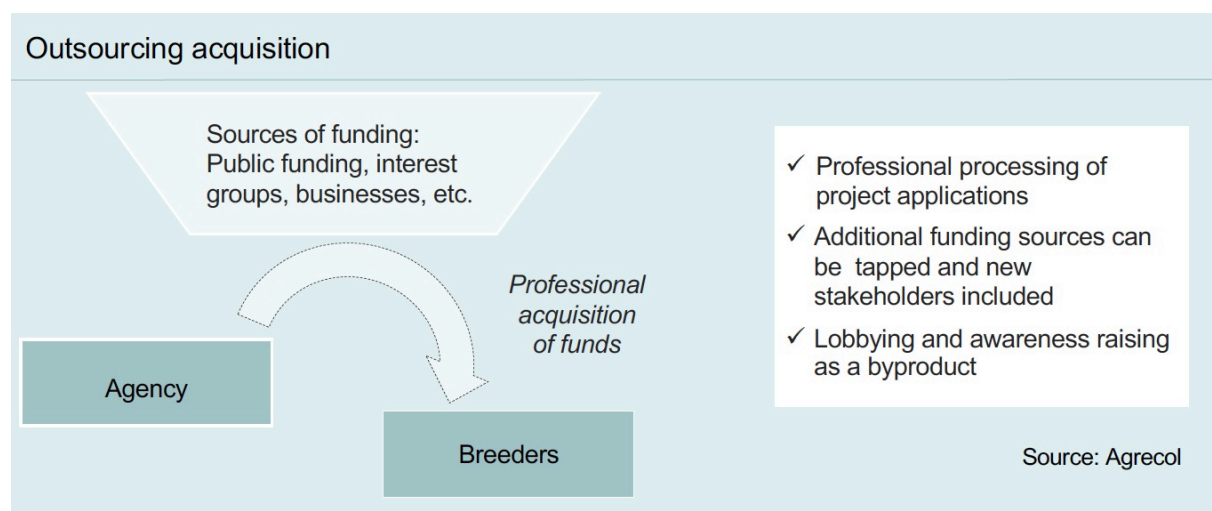
4.3 Outsourcing acquisition

At present, many breeders in the organic sector suffer from the high level of bureaucracy involved in acquiring funds. Much time that would be needed for the actual task of plant breeding is thus lost. This raises the question whether fundraising and possibly also financial management of funded breeding projects could be outsourced and delegated to a specialised service provider.

An organisation specialised in acquisition and accounting can work more professionally than most breeders can; this would lead to more efficient financing of plant breeding. Moreover, through such an agency, several small and medium-sized breeding projects can be combined into a larger programme, for which funds can then be raised jointly. This allows access to new funding sources, as some important sources can be tapped only above a certain level of funding, a level too high for individual breeders with their relatively small breeding programmes. In addition, an agency could involve new stakeholders such as:

- local authorities that are committed to regional development,
- organisations that want to promote biodiversity, or
- companies that are committed to environmental protection and strive for a greener image.

Another positive side effect of outsourcing acquisition and financial management should not be underestimated: an agency can represent the interests of breeders and act as a partner for lobbying and awareness raising.



A model that is between “do it yourself” and outsourcing is practised successfully by Kultursaat in Germany. Small-scale vegetable breeders formed an association, in which they set up a service unit for raising and managing funds. However, these funds are often not sufficient for their purposes, and the breeders raise additional money by themselves.

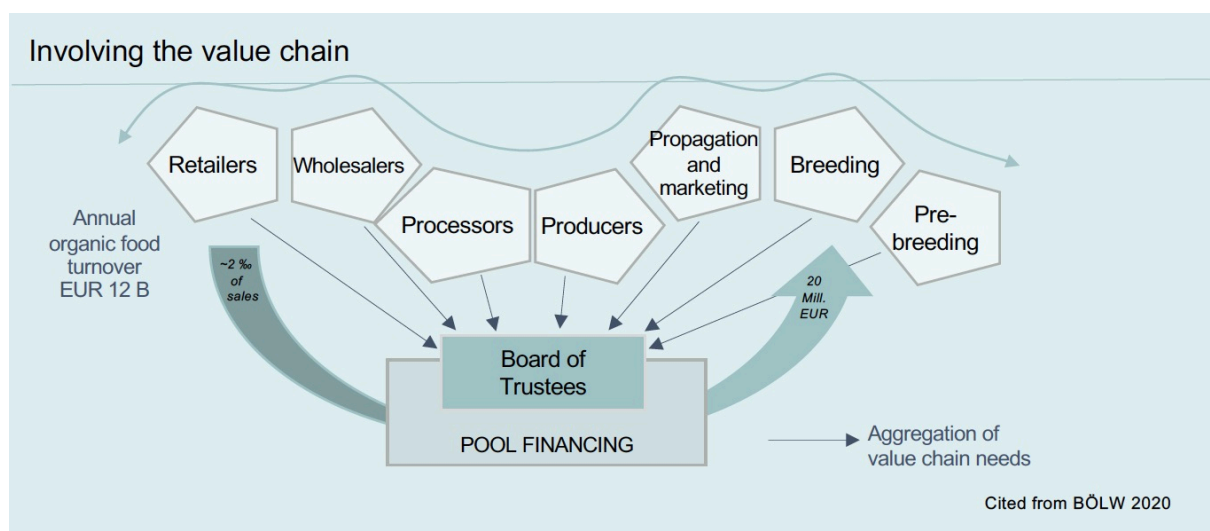
Completely outsourcing this function may allow more flexibility and openness for cooperation with very different customers and for the creation of breeding programmes with clear profiles but different consortium partners. The latter increases the chances of success in raising funds. Such agencies already exist in other sectors, for instance emcra, an agency for acquiring EU funding³⁷. Looking into their experience could bring important insights.

Whether by setting up specialised units internally or by outsourcing completely, a solution is needed that increases the budget for plant breeding. The work of such an agency would have to be financed by means of a fixed share of the funding requested. A percentage agreeable to all would need to be considered and determined by all parties.

4.4 Involving the value chain

Awareness is growing that organic plant breeding provides overall social and environmental benefits and that it cannot and should not have to completely finance itself^{38,39}. Therefore, investigations are underway to determine how not just growers but also processors, traders and consumers could contribute and thus support organic plant breeding:

- An alliance between trade and breeding was established already in 2007. Retailers organised under the umbrella of the association *Naturata International – Acting Together* and the association *Kultursaat* started the project FAIR-BREEDING. Retailers who join the initiative channel 0.3% of net sales of organic vegetables and fruit to organic plant-breeding initiatives over a period of ten years⁴⁰.
- Another project was set up by the *Software Foundation* in collaboration with the *Federal Association of Food Natural Products* in the form of a public–private partnership (PPP). The aim is to contribute a small portion (0.015%) of the sales of organic fruit and vegetables to breeding initiatives. It is crucial, however, that trade and breeding form a collective process⁴¹.
- The Local Varieties Project of the *Keyserlingk Institute* on Lake Constance regularly brings together breeders, farmers, millers and bakers for discussion of outstanding issues regarding production quantities, varieties and quality. Ten cents from the price of each loaf sold and made with flour milled from the local varieties flow back to the breeding initiative⁴².

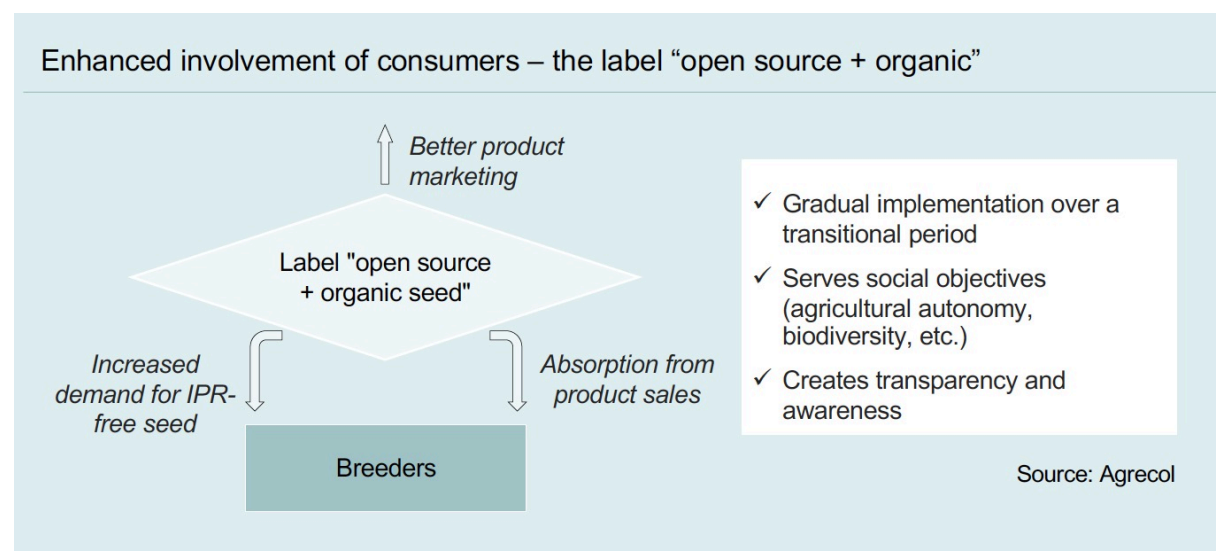


These examples share a common trait: retailers, processors and consumers involved in the projects want to act not so much as donors but rather as co-creators, sharing responsibilities in the process. Some companies indeed see their commitment as an investment. The proceeds from the value chain are still low in all cases, but the initiatives have great potential and send a positive signal to other companies. However, the real challenge lies ahead: to establish a funding mechanism that includes the value chain of the food sector as a whole. Efforts are being made by BOELW (Federation of the Organic Food Industry) in Germany with a fundraising target of 20 million Euro⁴³.

4.5 Enhancing consumer involvement – the label open source + organic

Consumers are key in achieving a successful fundraising strategy via the value chain. A high level of awareness-raising and public relations work is essential to encourage consumers to take part in financing plant breeding. Open-source is a strong buying argument for consumers: it stands for diversity and for seed as a commons. This gives plant varieties and their products a completely new marketing potential. Initial experiences with the distribution of open-source licensed varieties have shown that consumers appreciate this alternative to privatised seed. One example is the Sunviva tomato, which has now been added to the assortment of numerous seed traders; another is the wheat population Convento C, which gained popularity through sales of “open-source bread” in Berlin bakeries.

The great public interest in open-source licensing is based on the social perception that the current situation of privatisation and monopoly formation in the seed sector is not sustainable^{44,45}. The open-source seed licence gives individuals the opportunity to actively do something about it. Therefore, the introduction of an open-source label is likely to enjoy a high level of acceptance among consumers; indeed, it would be welcomed.



Open source can become a successful narrative that creates awareness among customers and emphasises the need for organic plant breeding. In this respect, the initiative of OpenSourceSeeds to introduce an open-source licence is a useful complement to the value-chain approach discussed above.

With the “seed as a commons” narrative and open-source strategies, the label can be secured as trademark protection for food from organically bred seed and vegetative plant material that cannot be patented or owned under any other IPR system. It is a way to systematically involve the end-user in the financing of organic breeding. A fee for the use of all labelled products would allow considerable sums of money to be generated and invested into commons-based organic plant breeding. In this context, the attribute “open source” gives organic breeding a very unique quality and added intrinsic value.

The label would also have an impact in widening consumer awareness about and support for organic plant breeding. Consumers can create a pull effect. Demand for commons-based organic seed will be increased and breeders will be encouraged to work according to the open-source criteria. Marketing companies can use the label to distinguish their products from the mass. Consumers are given the opportunity to take responsibility and make a concrete contribution to an alternative to the conventional seed market. Last but not least, consumers are made aware of the origin of the seed – an aspect related to transparency that has been completely neglected until now. Increasingly, processors and traders may feel obliged to join a trend of selling produce from commons-based organic seed and take the necessary measures step by step.

To implement this, a preparatory phase of at least one year and cooperation with various partners would be necessary. First of all, an independent organisation must be found or founded to design and manage the label, develop standards and find partners for certification. A non-profit association could be the appropriate legal entity. At least two larger companies in the food retail trade (supermarket chains) would need to start introducing the label into the market. Others could join later and at any time.

When introducing the label, it would make sense to start with some basic minimum standards and allow breeders to gradually make a transition into following a full-fledged set of criteria for open-source organic plant breeding, for example over a period of ten years. In order to assure the necessary commitment in this process, appropriate guidelines should be developed and regular inspections made. Although the guidelines would initially allow some level of tolerance, the transition period must be set with binding deadlines so that the system can be fully developed by a specific date. The introduction of such a label on the food market could boost the funding of commons-based organic plant breeding.

5 Summary and conclusions

In its way, conventional plant breeding has been very successful, but it does not fulfil the enormous tasks that are demanded from plant breeding today: the provision of ecologically adapted, genetically diverse varieties and the breeding of a broad range of cultivated plants.

Meanwhile, organic breeding has evolved as a new sub-sector that aims to meet these demands, but its growth is severely constrained by lack of funds. It is evident that the classical way – funding breeding through royalties from IPRs on seed and vegetative propagation material – does not work, because the key breeding objective of enhancing biodiversity and the use of IPRs are mutually exclusive.

The concept of seed as a commons offers a viable alternative. Free access to seed for breeding is a prerequisite for SMEs to exist or to start plant breeding. Diversity in the breeder landscape is essential to develop the urgently needed heterogeneity of efficient crop plants and their varieties. Therefore, a renaissance of SMEs in plant breeding is a necessary counter-movement to the growing IPR-based market concentration.

But a commons needs to be protected; here, open-source strategies can serve as effective protection mechanisms. Moreover, a commons needs to be financed. In the “old system”, farmers alone have to finance plant breeding; in a new commons-based seed system, society would shoulder the task.

It is also evident that the attributes “seed as a commons” and “organic” belong together. This paper proposes five ways to finance commons-based organic plant breeding. Involving the entire value chain and involving the consumers seem to bring the largest positive impact and have great potential.

The importance of finding new ways of financing and thus promoting strong growth in organic plant breeding cannot be overestimated. At present, there is no alternative that could create the urgently needed plant genetic diversity. Organic breeding is central, not only for the development of the organic market in Europe, but also for agriculture worldwide and for all sites where soil and climate do not offer optimal production conditions for conventional crops and varieties. Only if farmers in these areas have free access to suitable varieties that can be used sustainably will it be possible to secure our global food supply in the long term.

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Include the value chain - from wheat to bread





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