

## Bringing Commons elements into fruit breeding

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### Abstract

*Specific structures in fruit breeding and fruit cultivation have negative effects on food sovereignty, agrobiodiversity and sustainability in general. The concept of Commons is an alternative principle of resource management that carries the potential for a more sustainable use of natural resources, a democratization of resource governance, and for opening up experimental spaces beyond dominant management approaches. Five main characteristics from different Commons conceptualizations are applied to the organization of breeding to discuss the idea of commons-based fruit breeding: (a) normative entry points, (b) defined boundaries of both the community and the collectively managed resources, (c) collective management and participatory processes, (d) collective ownership of goods and resources, and (e) shared norms within the community. This approach potentially provides contributions to more sustainability in fruit breeding and cultivation.*

**Keywords:** Commons, sustainability, agrobiodiversity, food sovereignty, organic fruit breeding

### Motivation

Today's dominating structures of industrialized food production are mainly directed towards the goal of agricultural intensification and have realized high productivity increases since the 1940s (Silvey 1994; Loos et al. 2014). However, this development has been accompanied by a massive loss of agrobiodiversity and food sovereignty, together threatening the resilience of agricultural production itself (MEA 2005, Tilman et al. 2002, Windfuhr & Jonsen 2005). These negative sustainability impacts are also featured in the current system of fruit breeding and fruit cultivation. A significant portion of available fruit cultivars is marked by low genetic diversity and hence low vitality. For example, the major apple cultivars, that are commercialized in Germany, are genetically closely interrelated (Bannier 2011, Noiton and Alspach 1996). Genetic erosion (cf. Pistorius 1997; van de Wouw et al. 2009) and the focus of past breeding efforts on monogenic dominant resistances makes the modern apple varieties more susceptible against pests and diseases. Recently, this caused the breakdown of resistance against some sources of apple scab (*Venturia inaequalis*) (Bus et al. 2011).

Conventional, increasingly laboratorial breeding approaches do not match with the values and principles of organic (fruit) farming (cf. IFOAM 2017, Lammerts van Bueren 2010) in several aspects: They do no explicit testing for organic environments, do not explicitly focus on specific trait needs of organic systems, and aim for cultivars under variety protection, licensing agreements and club concepts, which restrict access to varieties and genetic diversity in general. Thereby, the food sovereignty of organic fruit farmers and consumers is impeded. Here, food sovereignty is understood as the right of individuals and communities to access sufficient, healthy food and its productive resources and to control their own food system (Windfuhr & Jonsen 2005, Kliem & Tschersich 2017). Fruit breeding has important societal functions, such as the production of high-quality products under minimized environmental impact, and the use of biodiversity to strengthen adaptive capacity in the face of climate change. Generally, these functions take second place behind economical aspects

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in the dominating conventional breeding structures (cf. Hanke & Flachowsky 2017, pp.154; DAFA 2017). A re-direction towards international sustainability goals, including biodiversity and improvement of agro-ecological resilience as well as food sovereignty, is needed.

'Commons', defined as institutions that enable the collective development, management and sharing of goods and resources (cf. Ostrom 1990; Hess 2008), are an alternative principle of resource management. It carries the potential for a more sustainable use of natural resources (Ostrom 1990, 2005), a democratization of resource governance (Benkler & Nissenbaum 2006), and for opening up experimental spaces beyond increasing economization and privatization of resources (Bauwens & Kostakis 2014). Some Commons principles are already being realized in the field of organic vegetable and grain breeding (Gmeiner et al. 2017; Kotschi & Rapf 2016; Wirz, Kunz, & Hurtr, 2017).

This paper discusses how a commons-organization could be implemented into fruit breeding and what this might imply for achieving core sustainability objectives, specifically agrobiodiversity and food sovereignty. First, the concept of Commons is introduced and core characteristics of commons-organizations from studies on both Traditional and New Commons are proposed (section 2). Afterwards, the authors discuss how each of these 'Commons elements' could be brought into fruit breeding approaches (section 3), illustrating this by the example of the organic fruit breeding initiative Apfel:gut in Germany (section 4). Finally, potential sustainability contributions of implementing a commons-orientation into fruit breeding are discussed (section 5).

### **The concept of Commons**

Commons as a scientific concept originally emerged in the field of economics, in the categorization of economic goods. Here, a common good is defined as a certain good with a low degree of exclusivity and a high degree of rivalry (Gordon 1954). Exclusivity means the exclusion of others regarding the usage of the good and rivalry describes the possibility of a simultaneous consumption or usage of the good. Common goods were established as an alternative category besides the classical distinction of Samuelson (1954) into public goods (low degree of exclusivity and rivalry, e.g. a lighthouse) and private goods (high degree of exclusivity and rivalry, e.g. a cheese).

This purely economic understanding of Commons as a certain category of goods has changed and broadened over the last decades, especially with the work by Ostrom (1990, 2005) who brought an institutional perspective into the debate. Ostrom's claim is that the social institutions – rules, norms and shared understandings – used to govern the common good (or rather: the common-pool resource) are as relevant as the resource itself. Therefore, both aspects cannot be viewed as separate entities. Ostrom defines these social institutions as common-property regimes (CPR). Thereby, she addresses the false assumptions and conclusions in Hardin's broadly reviewed article 'The Tragedy of the Commons' (1968), who established the argument that common goods ultimately have to be privatized because they are managed and used inefficiently. Hardin's famous example is a pasture open to everyone (as a common good), that becomes degraded and overgrazed because every user wants to maximize his individual profit.

Hardin's hypothesis experienced heavy criticism: He describes an open-access regime but not a CPR, where access usually is restricted and the usage of the good is managed through social institutions (Ostrom 1990, Hess & Ostrom 2007). In contrast to Hardin, Ostrom (1990) conducted a number of case studies regarding success, failure and change of different CPR-institutions in the agricultural and fishery sector (e.g. irrigation services, grazing lands, inshore fisheries, forests). As a result, she developed eight so-called design principles for

the successful long-term (and sustainable) governing of common-pool resources. These are the following (Ostrom 1990, p. 90ff):

1. Clearly defined boundaries: A clear distinction between users and non-users of the CPR and their respective rights regarding the resource(s) is made.
2. Congruence of rules: Withdrawal and provisioning rules are economically compatible and adapted to local conditions.
3. Collective choice arrangements: Every user who is affected by the rules can participate in their modification through collective choice mechanisms.
4. Monitoring: Compliance with the CPR rules is effectively monitored by the users themselves and/or monitors accountable to the users.
5. Graduated sanctions: Users who violate the rules regarding the management of the CPR receive graduated sanctions, depending on seriousness and context.
6. Conflict resolution mechanisms: An immediate access to low-cost conflict resolution mechanisms is given to solve conflicts between users or between users and non-users.
7. Recognition of rights: The rights of the community to make their own rules, and hence the established CPR, is recognized and respected by other external (e.g. governmental) authorities.
8. Nested enterprises: If a connection of the CPR to a larger social or environmental system is given, polycentric governance in a nested hierarchy takes place.

Hess (2008) categorizes these types of Commons as Traditional Commons. However, with further research and a growing social movement in the field of Commons, the so-called New Commons emerged as a separate branch (*ibid.*). New Commons generally refer to the management of material and non-material goods beyond the sector of natural resources and common-property regimes. They emphasize the active creation of an institutionalized community and further add aspects of trust, participation and normative goals or premises (Hess 2008, Hess & Meinzen-Dick 2006). In this conceptualization, the term Commons is an umbrella for the community, their resources and their institutions for collective creation and management. Prominent examples are Knowledge Commons (e.g. Wikipedia), where information, data or other knowledge resources are shared inside an institutionalized community for the sake of sharing or actively creating new knowledge resources (Frischmann et al. 2014). Another relevant subsection of New Commons are Global Commons, defined as resource domains which belong to the global community and which all people (or rather nations) should have access to, e.g. biodiversity, global climate, air and water quality at large geographical scales (Buck 1998, Byrne & Glover 2002, Stern 2011). Plant varieties can also be seen as a Global Commons, as they represent biodiversity (Berkes 2007, Mudiwa 2002). Essentially, this means that any private, public, or open-access good can be transformed into a common good.

In summary, the concept of Commons is characterized by three dimensions: (i) the material or resource dimension, (ii) the social dimension, encompassing the user-community that builds around the resource, and (iii) the regulative dimension, referring to the rules and norms for the governance of the resource by the community (Helfrich 2014). This conceptualization opens the approach for both Traditional and New Commons. Fruit Breeding intersects both types of Commons and therefore bridges both conceptions. For instance, the crossing, as well as the cultivation, selection, and management of seedlings is essentially an agricultural process and therefore an object of Traditional Commons. Secondly, breeding is also an intellectual process and developed varieties represent genetic diversity. These aspects are a concern of New Commons, specifically of Knowledge Commons and Global Commons (Wolter & Sievers-Glotzbach 2017). Thus, we propose the

following five core characteristics from both Traditional and New Commons conceptions as potential elements that are relevant for fruit breeding:

- a. Normative entry points: Reflecting the New Commons discourse, Hess (2008, p. 5) defines entry points as “catalysts that change one’s conception of a resource as a private, government-owned, or open-access resource into a commons”. These catalysts regularly have a normative character (e.g. the intrinsic need to protect biodiversity) and are of importance for the integrity and goals of the user community.
- b. Degree of openness: According to Ostrom’s first design principle (see above), the boundaries of both the community and the collectively managed resources as well as the rules for sharing resources outside the Commons have to be determined. This allows to protect the Commons in the long-term, while making other eventual sharing mechanisms with actors outside the community possible.
- c. Collective management and participatory processes: Collective choice arrangements for managing the Commons as described by Ostrom (see above) are combined with the participation opportunity of every user in the creation of the common resources. This acknowledges the active creation of the Commons and emphasizes the social dimension.
- d. Collective ownership of goods and resources: Resources that are managed inside the Commons are the shared property of all users as a common good. However, if certain goods such as resource domains of Global Commons are being touched, this special character has to be taken into account regarding joint ownership rights.
- e. Shared norms within the community: Linked to the normative entry points, shared norms are the basis for mutual trust and build a coherent narrative for Creating and Sustaining a New Commons, emphasizing the particular social and/or economic context of the community.

These five Commons elements enable a structured application of the concept of Commons to fruit breeding and will be further discussed in the next section.

### **Commons-based fruit breeding**

By aligning the identified Commons elements with fruit breeding, a possible conceptualization of commons-based fruit breeding will be described (for illustration see figure 1). The theoretical elaborations will be connected to already existing aspects of breeding organization that reflect Commons principles. Further, commons-based fruit breeding will be illustrated by the example of the organic fruit breeding initiative Apfel:gut in Germany that incorporates Commons elements into its organizational structure and can thus be regarded as a pioneer in this field (see chapter 4).

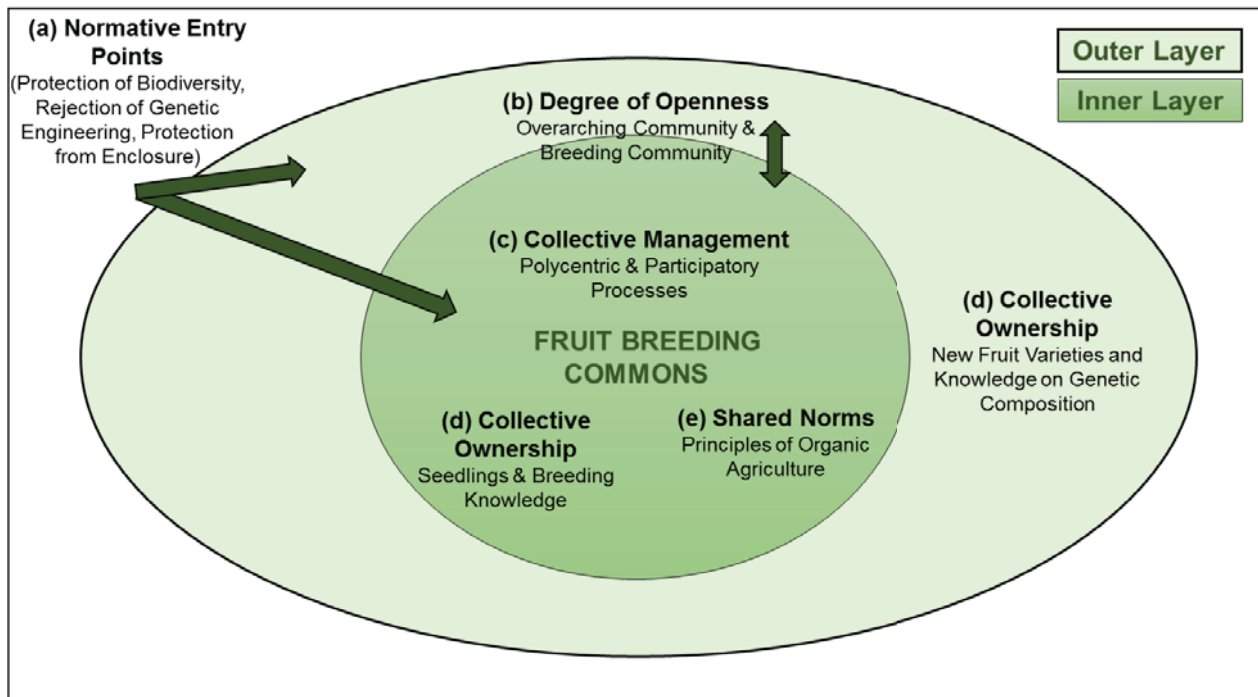


Figure 1: Conceptualization of commons-based fruit breeding. Source: Own research.

(a) **Normative entry points.** When seriously acknowledging the Global Commons character of fruit cultivars as carriers of agrobiodiversity and the societal functions of fruit breeding, breeding organizations need to detach from solely economic objectives. A general entry point for creating New Commons as such is the protection of societally valuable goods and resources from privatization and commodification (Hess 2008, p. 6). This may also prove to be a catalyst for the creation of Commons in fruit breeding because the diversity of and the access to fruit varieties is threatened by increased privatization, e.g. through club concepts and patent mechanisms. However, in agricultural spheres normative entry points typically have a strong ecological dimension – in general the protection of the resource base or the preservation and enhancement of biodiversity and multiple ecosystem services. Particularly in fruit breeding, the broadly perceived need to strengthen the vitality and genetic diversity of the fruits (Ristel, Sattler & Bannier 2016, Byrne 2012) can be a powerful catalyst, as the example of Apfel:gut shows (see figure 2). Specifically, in the context of organic farming, the rejection of genetic engineering methods (IFOAM 2017) may prove to be another relevant entry point into a commons-based organization. It shows that normative entry points are potentially and significantly shape the breeding goals and methods.

(b) **Degree of openness.** If a commons-based organization is to be implemented, the question arises how to define the boundaries of the community and the collectively managed material and non-material resources. For fruit breeding, it is helpful to distinguish between the breeding community and the overarching community of users of new fruit varieties (e.g. fruit farmers, breeders, retailers, consumers). Implementing a commons-orientation in the fruit breeding process would entail the sharing of physical resources (seedlings, fruits etc.) and breeding knowledge within a closed breeding community. However, for realizing a commons-orientation in the management of the resulting new fruit varieties, knowledge on the variety characteristics needs to be shared with a global community and intellectual property rights should be avoided (see d). Hence, by organizing fruit breeding as a Commons, two layers of commons management need to be considered (Wolter & Sievers-Glotzbach 2017). The inner layer describes a clearly defined breeding community, where seedlings and scions, as well as breeding and farming knowledge is shared according to

certain formal and informal rules. In the outer layer, knowledge about the genetic composition of new fruit varieties and the breeding process is shared with a more open user community. Additionally, newly developed fruit varieties have to be made accessible. The outer layer gives credit to the Global and Knowledge Commons character and helps to protect and develop biodiversity.

(c) **Collective management and participatory processes.** An existing approach to implement this Commons element into fruit breeding is the concept of participatory plant breeding (Ceccarelli 2012), meaning that breeding takes place on-farm and farmers as the actual users of plant varieties are involved in the selection process. Ristel and Sattler (2014) specified the concept of participatory breeding for the organic fruit sector. Including different farms from different locations into a participatory breeding structure is argued to be beneficial for realizing regional adaptability of the developed varieties (Lammerts van Bueren 2010). This also implies decentralized decision-making structures regarding the care-taking of seedlings and selections. As a result, the total pool of material resources is managed collectively in different decentral units (in the inner layer, see b). However, by implementing collective choice mechanisms, all participants are allowed to take part in the elaboration of overarching rules, such as breeding goals or the sharing of resources (see b). This collective rulemaking and management helps to control the long-term breeding process by negotiating actions and principles that satisfy all the participants and therefore respects all normative entry points (see a) and other personal opinions.

(d) **Collective ownership of goods and resources.** Hess (2008, p. 6) emphasizes the “sense of sharing and joint ownership” she observes in all types of New Commons. A collective management of material and non-material resources in the breeding process (inner layer) necessitates the transfer of these resources into the collective ownership of the breeding community. As a result, seedlings that are planted on private land/orchards of the participating farmers or other organizations are the (common) property of the whole community. Moreover, to implement a commons-orientation into the resources that are settled in the outer layer of the Commons (knowledge about the genetic composition, new varieties, see b), the global community has to be (or remain) in collective ownership of them. Only then can biodiversity as encapsulated in varieties remain a Global Commons (see chapter 2). This restricts the use of variety protection mechanisms or other intellectual property rights. Instruments and business models have to be found that correspond with the Commons character described in (b). A possible instrument that could be suitable for the implementation of the global collective ownership perspective can be found in vegetable breeding with the instrument of an open source license for seeds (Kotschi & Rapf 2016).

(e) **Shared norms within the community.** Shared norms in fruit breeding can be found in the principles of organic agriculture. An example are the IFOAM (2014) ethical principles of organic agriculture: Health, Ecology, Fairness and Care. Lammerts van Bueren (2010) describes these as influencing factors for the whole (plant) breeding process. Diverse personal motivations (normative entry points) and cultivation methods (possible through decentralized breeding structures) can be bundled under this ‘normative frame’, still respecting individual attributes of the participants. However, other norms besides the principles of IFOAM can possibly act as connecting themes in the Commons, as long as they are in line with the other Commons principles. This normative frame is an essential element for building trust within a community, especially because fruit breeding is a long-term process.

### **Apfel:gut as a pioneer of commons-based fruit breeding**

The initiative Apfel:gut under the umbrella of Saat:gut e.V. describes itself as a participatory organic breeding organization, aiming for the development of robust organic apple and pear varieties, and has been operating since 2011 (Ristel & Sattler 2014, Ristel, Sattler & Bannier 2016). Apfel:gut has been the object of investigation in a case study that examines the organization as an example for commons-based fruit breeding (Wolter & Sievers-Glotzbach 2017). All participants in this initiative have specific normative entry points to take part in the Commons, which are to some point similar and include ecological, political and personal motivations. However, all share the norms of organic agriculture. Participating farmers actively practice organic fruit cultivation according to Bioland or Demeter guidelines. Seedlings and farming/breeding knowledge are shared as collectively owned resources inside the breeding community. Knowledge about the breeding process (e.g. what is crossed with what?) is shared to a certain degree with all interested parties outside Apfel:gut. The aim is to give free access to new eventually developed apple and pear varieties, although the detailed procedure of how to make this happen is not discussed yet.

### **Conclusion**

An enhancement of the genetic diversity of fruit cultivars can be expected from both a commons-orientation in the breeding process (inner layer) and a commons-orientation in the management of the resulting fruit varieties (outer layer): First, the establishment of several commons initiatives, such as the project Apfel:gut, potentially increases genetic diversity of future fruit cultivars that are in common (organic) cultivation. Second, a greater genetic diversity of cultivars in overall fruit growing can be expected from implementing collective ownership arrangements. The opening up of varieties to the development by everyone potentially encourages new dynamics and innovations (cf. Benkler & Nissenbaum 2006).

Commons-based fruit breeding can enhance food sovereignty in (at least) three respects: First, the access of farmers and breeders to varieties is seen as an integral part of food sovereignty (Kloppenborg 2014). By implementing collective ownership arrangements on newly developed fruit cultivars, fruit farmers and breeders gain the right to multiply them and to further breed with these cultivars. Second, the conceptualization of commons-based fruit breeding includes access of the overarching user community not only to fruit varieties, but also to the information on the breeding process. Such transparency is a precondition for allowing fruit farmers and consumers to decide according to their ethical values (e.g. the rejection of certain genetic engineering methods). Third, commons-based fruit breeding opens up spaces for fruit farmers to actively participate in shaping the breeding structures that affects their daily work. Especially organic fruit farmers can start breeding initiatives that are based on organization principles coherent with IFOAM (2017).

If a commons-orientation is actually implemented in (fruit) breeding, two core practical challenges arise. The first challenge is to secure the long-term financing of fruit breeding, if varieties are kept open and cost-free accessible to all. Alternative income sources could possibly be created through new financing mechanisms along the value chain, as already partly established in the field of vegetable breeding (Kotschi & Wirz 2015). The second challenge is to protect the common good character of newly developed fruit varieties from enclosure. A possible protection mechanism could be the registration of new varieties to non-commercial organizations (such as considered for the case of Apfel:gut) or the usage of open-source licenses or pledges (Kliem & Tschersich 2017).

Concluding, commons-based fruit breeding presents a promising approach specifically for the organic fruit breeding sector to develop innovative strategies for enhancing agrobiodiversity and food sovereignty, and for credibly realizing the principles of organic

agriculture – including issues of intellectual property rights, process transparency, and participatory breeding approaches (IFOAM 2017).

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