

Governing landraces and associated knowledge as *commons*.

From theory to practice

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Abstract

We examine the governance of landraces and associated knowledge in Spain focusing on actions to maintain them in the public domain and to manage them as commons. We first examine the international mechanisms promoting conservation of landraces and associated knowledge in the public domain and the actions by the Spanish state to apply such regulations. We then explore the efforts of the Spanish seed network and a group of scientists to manage them as commons. The analysis of the interactions between the public and the commons regimes led us to conclude that landraces and associated knowledge would be better managed under a combination of governance regimes.

1. Introduction

Landraces, also called local or traditional varieties, are dynamic and variable populations of cultivated plants that have been selected and adapted by farmers to their local environmental and cultural conditions, but that lack formal crop improvement. Landraces are identifiable to the naked eye and usually have local names that differentiate them from other varieties of the same species (Negri, 2007, Calvet-Mir et al., 2011). Most landraces are propagated by seeds, but some are also vegetatively propagated by tubers, bulbs, or stem cuttings. Landraces are intrinsically linked to the traditional knowledge needed to select, improve, and adapt them to the local environment. This knowledge includes information regarding the description of morphologic, agronomic and sensorial characteristics of landraces, the local evaluation and selection criteria, as well as landrace management (e.g., specific sowing, planting, and harvesting calendar, type of manure, rotations, storing) and use (e.g., culinary, fodder, medicinal) (Calvet-Mir et al., 2010). Therefore, landraces and associated knowledge can simultaneously be considered part of the natural and the cultural heritages (Halewood, 2013).

As other resources, landraces and associated knowledge can potentially be managed under different governance systems. Thus, landraces and associated knowledge are low excludable and non-rival resources that –according to the circumstances- have been left ungoverned or have been governed by private property rights (i.e., as resources owned by a person or a group who decides on their use and management), by public property rules (i.e., as resources that can be used by members of a society who follow state-decided rules), or by a commons regime (i.e., as shared resources managed by a group of people who negotiate their own rules through social or customary traditions, norms and practices). Indeed, over the past 100 years the governance of landraces and associated knowledge has experienced an important shift

in governance regimes. In some countries, this shift has been largely marked by the inclusion of landraces and associated knowledge into the private property regime through instruments such as Plant Breeder's Rights (PBR) or patents granted to breeders or companies that modify and stabilize some of the genetic traits of crop varieties (Whitt, 1998, Brush, 2004, Shiva, 2004, Ghijsen, 2009, Halewood, 2013).

Given that the inclusion of landraces and associated knowledge into the private property regime has often resulted in the dramatic situation that farmers have no recognised rights on the plants they have developed and continue to grow (Brush, 2004, Thomas et al., 2011), the process has not gone without reaction. Some scholars have argued that farmers should be protected through the application of some sort of Intellectual Property Rights that recognize and compensate the cumulative work of generations of farmers in developing particular varieties (Brush, 2004), a position that claims for more rights for farmers without challenging the governance of landraces via private property rights. In the same line, political initiatives such as the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) aim to regulate the compensation that companies developing commercial products based on landraces and associated knowledge should provide to farmers (i.e., benefit sharing). Differently, other authors have opposed the privatization of landraces and associated knowledge suggesting that both resources are already in the public domain and should be governed as a public good (Shiva, 2004, Smale et al., 2004). Authors supporting this view have argued that the inclusion of landraces in registries and databases can be used to contest intellectual property right claims by commercial companies, as the inclusion of landraces in registries invalidates the condition of novelty required for the granting of patents (Lakshmi Poorna et al., 2014, Casañas et al., 2017). Still other scholars and

other stakeholders argue for an open access governance regime that ensures that germplasm can be freely exchanged now and in the future, proposing the creation of an open license for varieties emulating the ones used in free software of Creative Commons (Deibel, 2013). For example, the Open Source Seed Initiative (OSSI, www.osseeds.org) seeks to provide an alternative to intellectual property rights agreements that restrict freedom to use plant germplasm (Kloppenburg, 2010, Luby et al., 2015). Finally, researchers have recently started to argue that landraces and associated knowledge could also be governed as *commons* (Aceituno-Mata et al., 2017, Reyes-García et al., 2017).

The *commons* governance framework refers to the institutional approach that governs the production, use, management and/or preservation of shared resources according to which people manage resources by negotiating their own rules through social or customary traditions, norms, and practices (Ostrom, 1990, Frischmann et al., 2014). Resources managed under the *commons* approach are collectively owned and managed by self-organized communities for their own benefit (Quilligan, 2012). A distinctive aspect of the *commons* approach is that it emphasizes that social dilemmas, or situations in which there is a conflict between immediate individual self-interest and long-term collective interest, can be solved through resource-use management rules self-defined by the users (Ostrom, 1990, MacKinnon, 2012). Another distinctive characteristic of the *commons* approach is that, under this governance system, resources are managed to ensure long-term production, rather than short-term benefit, for which management is oriented to prevent resource degradation (Kostakis and Bauwens, 2014).

Originally, the *commons* framework was developed to understand the governance of physical resources with low excludability and high rivalry, such as woods or fisheries, but over the last years, the framework has been expanded to understand the governance of immaterial and

non-rival resources, such as knowledge (Boyle, 2003, Hess and Ostrom, 2007, Bollier and Helfrich, 2014, Kostakis and Bauwens, 2014). The idea that knowledge could be peer-governed by knowledge users has mostly been developed by scholars working on the governance of digital knowledge, with the governance of other types of knowledge, such as traditional knowledge, being less explored. While the technological revolution opens up the possibility of making traditional knowledge accessible to all kinds of users around the globe and brings growing concerns over its misappropriation (Boyle, 2003, Oguamanam, 2009), research on knowledge commons can provide innovative ways for the governance of this type of knowledge.

In this chapter we examine the governance of landraces and associated knowledge in Spain. We focus on efforts to maintain them in the public domain and to manage them as commons. In the next section, we examine the international mechanisms that promote conservation and use of landraces and associated knowledge in the public domain and the actions by the Spanish state to apply such international regulations. The following two sections present the coordinated efforts by Spanish civil society and academicians to strengthen the governance of landraces and associated knowledge as *commons*. We start describing the actions of the non-governmental organization ‘Red the Semillas’ (RdS, the Spanish seed network) to manage landraces as commons and then describe the efforts of a group of scientists in coordination with the civil society to manage landraces knowledge as a common. The interactions between the public property and the commons regime are explored in the discussion section.

2. The public domain: Laws, registers, and inventories

With the aim to regulate the access and management of landraces and associated knowledge, the international community has put in place some regulatory agreements that

signatory countries are then expected to apply. The largest agreement raising issues of access to and conservation of genetic resources and farmer's rights is the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), which was adopted in 2001 and entered into force in 2004. Spain ratified this treaty and included its directives in the Law 30/2006 on seeds and plant genetic resourcesⁱ. A recent Royal Decree (199/2017) develops the framework for the conservation and use of plant genetic resources, assigning the responsibility of the *ex situ* conservation of germplasm to the National Program Collections of Plant Genetic Resources, a network formed by 37 public institutions with gene banks, coordinated by the National Plant Genetic Resources Centre, and reliant on the Ministry of Economy, Industry and Competitivenessⁱⁱ. While the Decree is new, the network has been active for many years and nowadays maintains more than 77.000 entries from which 34.000 correspond to vegetables, pulses, and winter cereals landraces (De la Rosa and Martin, 2016).

At the European level, there are also specific regulations regarding the marketing of plant reproductive material of agricultural, vegetable, forest, fruit and ornamental species. These regulations are largely oriented to ensure that criteria for health and quality are metⁱⁱⁱ, but they also require the registration and certification of varieties (or plant reproductive material including landraces)^{iv} before commercialization. Following EU regulation, in Spain there are two different registers. The first register includes protected varieties that met the requirements of novelty, distinguishability, homogeneity, and stability. This register is mostly being used by companies registering new bred varieties. Registration grants a special type of property, limited in time. The second register includes varieties that can be commercialized in Spain and, in many cases, in the whole EU. To be included in this register, a variety needs to have been described in a public institution following established protocols. Landraces can be included under a commercial

category but also in this second register under the category of ‘conservation varieties’ (for horticultural varieties and cereals) or – in the case of horticultural varieties – under the category of “varieties developed for growing under particular conditions” (also known as ‘varieties with no intrinsic value for commercial crop production but developed for growing under particular conditions’). In the last decade, 98 landraces from 20 crop species have been included in this register (70 as conservation varieties and 28 as varieties without intrinsic value)^v. Only varieties in the public domain can be registered in any of these two categories.

Policy makers’ interest in maintaining the traditional knowledge associated to landraces in the public domain is more recent. Indeed, the importance of traditional knowledge for the conservation and sustainable use of biodiversity was only internationally highlighted in 1992, by the Convention on Biological Diversity (CBD, UN 1992). Some years later the official recognition of the relation between traditional knowledge and agricultural biodiversity was also made by the ITPGRFA (FAO 2001). Specifically, Article 9.2 of the ITPGRFA points out that each Contracting Party should, as appropriate and subject to its national legislation, take measures to protect and promote Farmers’ Rights. These measures include *i*) the protection of traditional knowledge relevant to plant genetic resources for food and agriculture, *ii*) the right to equitably participate in share benefits arising from the utilization of plant genetic resources for food and agriculture; and *iii*) the right to participate in national level decision making on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture. In Spain, this strategy is embodied in Law 30/2006, which acknowledges that public efforts should be done to protect, preserve, and promote the traditional knowledge relevant to plant genetic resources cultivated in the different regions of Spain, to promote the participation

on the benefit-sharing, and to facilitate farmers the conservation, use and trade of landraces seeds and plants in agreement with the seeds and nursery plants legislation.

In order to fulfil the Spanish law, in 2016 the Spanish Ministry of Agriculture launched a project to develop the Spanish Inventory of Traditional Knowledge on Agricultural Biodiversity (IECTBA, acronym in Spanish). Under this project, a multidisciplinary group (formed by scientists from several research centres and by the RdS)^{vi} is developing a public inventory that aims to compile previously published information on traditional knowledge regarding agrobiodiversity at two levels: species and landraces. The expected result from this effort will be a global database available to the general public on-line and a publication compiling the methodology and lists of traditionally cultivated species and landraces. The effort will also produce monographs summarizing all the information compiled, starting with 50 emblematic species and landraces.

3. Moving towards the management of landraces' plant material as a common: Red de Semillas

In parallel to the efforts to establish mechanisms that would allow regulating the maintenance of landraces and associated knowledge in the public domain, there have been efforts proposing the governance of landraces and associated knowledge under the commons governance system. In Spain, the largest coordinated effort for the governance of landraces as *commons* is being done by the Spanish seed network, 'Red de Semillas: Resembrando e Intercambiando' (RdS). The RdS is a non-profit, decentralized organization created in 1999 with the aim to encourage the sowing and exchange of landraces (<http://www.redsemillas.info/>).

The RdS considers landraces a common resource and reclaims farmer's right to produce, exchange, and sell their own seeds and seedlings. The RdS brings together more than 20 regional and local seed networks from all over Spain, forming a very diverse, dynamic, and geographically dispersed group of stakeholders. Actors in this network range from peasants and farmers' organisations, to seed and seedling artisanal producers, gardeners, technicians, agricultural experts, responsible consumption organisations, organisations for the promotion of organic agriculture and agroecology, community gardens, university staff and students, members of ecologist organizations and researchers (Red de Semillas, 2015).

Local seed networks within the RdS carry out various actions to maintain and defend agricultural biodiversity as a commons. One of its main activities is the dynamic management through Community Seed Banks^{vii} in which professional and amateur farmers find a space for access and exchange local plant reproductive material. Community Seed Banks operate in many different ways with the goal to ensure seed's renewal. In some Community Seed Banks people who borrow seeds, must return them after completing an agricultural cycle; in others, landraces are grown by members of the association; still others operate under an exchange or donation system. To support the maintenance costs of the banks, local networks use own funds and some networks sell seeds at markets and fairs.

Several local seed networks have also launched other tools or alliances for the production, use, management, and conservation of landraces. For example, some have encouraged the development of networks of farmers who sponsor varieties (also called 'guardians' or 'farmers-researchers'). These networks have different purposes, including to decentralize efforts for multiplying varieties, to sow landraces that are in public germplasm banks, so that farmers can test and –potentially- adopt them, or to encourage the participatory

testing and/or breeding of landraces, generating collective knowledge about the landraces and selecting the reproductive material that best adapts to the needs of farmers and consumers. Sponsored landraces come from a variety of sources including farmer's exchange, prospecting work carried out by the local networks, community seed banks, and public germplasm banks. To ensure the quality and health of the propagation material, the RdS is dedicating significant efforts to develop protocols for seeds production. Lastly, the RdS also supports small-scale seed producers cultivating open pollinated varieties for commercialization. These micro-enterprises typically produce small amounts of seeds from a wide range of, often not-registered, landraces and sell them to gardeners and farmers. As they supply farmers with varieties that are otherwise no longer available in the market, small-scale seed producers contribute to halt genetic erosion and promote *on farm* agrobiodiversity conservation.

Local seed networks in the RdS also conduct training and consultancy activities and traditional knowledge recovery projects. The promotion of genetic and cultural heritage among consumers is carried out through information and awareness activities such as information points, workshops, and tasting fairs. The RdS has also conducted lobbying work and legal amendments, aiming to unravel the complex legislation on seeds and ascertain its effects on farmers. Moreover, the RdS has constructed alliances with the international movement, being, for example, an active member of the European coordination 'Let's Liberate Diversity!' It also collaborates with several international platforms and seed networks from Latin American and other regions (Red de Semillas, 2015). In sum, the RdS defends that landraces are non-exclusive resources and promotes their use in two different ways: 1) making seeds easily available to farmers and gardeners to promote their grown (in some cases taking out landraces from public

seed banks and redistributing them among farmers) and 2) disseminating the particularities of landraces, to promote their consumption.

The maintenance of landraces under the commons governance system allows conserving a biological resource collectively and encouraging participatory plant improvement (Aceituno-Mata et al., 2017). This is so because, as farmers are the ones directing the improvement, they can adapt landraces to respond both to environmental changes and to their local use and management needs. Additionally, the contribution of each farmer might impact the entire agricultural community through the exchange of the improved varieties. The commons management of landraces implies that the more exchanges are made, the more diversity is generated. Maintaining landraces under the commons governance system benefits both farmers, who have more autonomy to select and choose their seeds, and consumers, since they have a larger diversity of food available. Finally, this form of collective management potentially also favours the conservation of agricultural biodiversity, since it decentralizes conservation efforts and motivate farmers to maintain and increase biodiversity by exchanging with other farmers (Aceituno-Mata et al., 2017).

4. Landraces' associated knowledge in the common domain: CONECT-e

In the same way that there have been efforts proposing the governance of landraces under the commons governance system, there are also efforts to govern landraces' associated knowledge as a knowledge commons (Hess and Ostrom, 2007, Frischmann et al., 2014). There is some evidence to suggest that landrace knowledge has been traditionally governed by local communities under the commons framework (Reyes-García et al., 2017). For example, a study of the governance of landraces and its associated knowledge carried out in Vall Fosca, a rural

Pyrenean valley of Northeastern Spain, suggests that traditional knowledge associated to landraces is governed under the commons framework. Landrace knowledge hold by gardeners in Vall Fosca is managed through an informal social network of seeds exchange with its own rules and participatory property regime. Such seed management system, not only ensures landraces *in situ* conservation, but it also promotes cultural identity and social cohesion (Reyes-García et al., 2017).

Until recently, landraces and landraces knowledge were mainly exchanged among communities living in nearby territories, such as Vall Fosca, a situation that might have favoured some of the design principles for the maintenance of a commons governance system (e.g., a clear group boundary, rules adapted to local needs and conditions, or self-organized communities, Ostrom, 1990). However, the new technological development allows for a different transmission of this type of knowledge. Indeed, digitalizing landraces knowledge opens up the possibility of making it accessible to all kinds of users around the globe, with growing concerns over the facility to misuse –or misappropriate- it (Oguamanam, 2009). There are, however, ways to continue managing digitalized landrace knowledge as a commons. In what follows, we explore one initiative aiming to digitalize landraces knowledge to preserve it while maintaining it in the commons domain: the platform CONECT-e.

CONECT-e (Compartiendo el CONocimiento ECologico Tradicional, www.conecte.es) is a Wikipedia-like citizen science platform aiming to gather and promote the sharing of all types of traditional ecological knowledge in the Spanish territory. The initiative aims to complement traditional knowledge exchanges that happen in close physical and territorial boundaries with exchanges among an extended community of potential users that are not physically linked. CONECT-e can be considered a digital knowledge commons because the resource (digitalized

traditional knowledge) is shared by a community (formed by the registered users that contribute with their knowledge to the platform) with a peer to peer (P2P) governance system that guarantees resource maintenance, thus fitting into the description of knowledge commons provided by (Kostakis, 2010).

CONNECT-e has a specific section devoted to landrace knowledge. To address both academic and civil society concerns, this section was designed by researchers in tight collaboration with members of the IECTBA (see Section 2) and the RdS (see Section 3). To be able to contribute landraces knowledge to the IECTBA, the section on landraces in the platform CONNECT-e closely resembles the structure of the IECTBA, for which knowledge collected in the platform could complement the national inventory. To address issues of misappropriation, all the content of the platform is protected under a copy left license (a way to guarantee non-exclusion by allowing reproduction and exchange of intellectual products such as software code, art or information). CONNECT-e's content is protected under a Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0). This license requires that any product using original or modified content is protected under the same legal framework, impeding the establishment of copyright licenses, such as trademark rights, over it. In sum, the landrace section in CONNECT-e creates a dynamic inventory of landraces and associated traditional knowledge, which –at the same time- helps complement national databases and can be useful to contest issues related to the misappropriation and enclosure of landraces knowledge, thus being an example of governing landraces digitalized knowledge as commons.

5. Discussion

In the previous sections we have described separate actions by the Spanish administration on one side and researchers and the civil society on the other in relation to the management of landraces and associated knowledge. Following international directives, the actions by the Spanish administration mostly revolve around landraces *ex-situ* conservation in gene banks under public governance, the use of national registers, and the funding of the IECTBA. Efforts by the civil society include emphasis in *on-farm* conservation, the development and enforcement of farmer's right to produce, exchange, improve and sell their own seeds, and the creation of an on-line platform open to society for the compilation of landraces associated knowledge.

While the current legal mechanisms in place have made attempts for the conservation and regulation of the public governance of landraces, they still present important loopholes that conflict with commons governance. For example, the Royal Decree 199/2017 does not regulate important aspects for the sustainable management of plant genetic resources (e.g., tools against biopiracy or the role of civil society promoting the dynamic management of landraces). The decree does not address issues related with farmers' rights either (e.g., landraces direct-selling or landraces seeds farmer's micro-enterprises) and leaves *in situ* conservation measures to be developed in accordance with budget availability. In the same way, neither the law for the protection of plant varieties (Law 3/2000) nor the law regulating patents (Law 24/2015) oblige companies to declare the landraces used in the development of new varieties and products, which makes difficult to control whether companies do respect agreements on access and benefit-sharing established by the ITPGRFA and included in article 51 on Farmers' Rights in the Spanish Law on Seeds and Nursery Plants. National registers, while being an important first step, also present important limitations for the governance of landraces. For example, the inclusion of a landrace as a 'conservation variety' requires the same level of stability and only 10% less of the

homogeneity criteria, conditions that exclude most landrace populations. Moreover, the actual registration process is still rather complex and tedious, which discourage members of the civil society aiming to register landraces.

The loopholes just presented are not only rhetorical, but have real implications. For instance, the inclusion of landraces in national registers is the only procedure provided by governments to allow the commercialisation of seeds and it can be used to protect registered landraces and landraces names from misappropriation by seed companies and other institutions. However, the conditions currently established by the register are not fully adapted to local populations and to how these landraces are currently being managed by farmers. For example, the category “conservation varieties”, developed for landraces, limits in quantity and geographical extension the production and commercialization of registered landraces. Thus, the production, valorization and promotion of these varieties are hindered. Moreover, small-scale seed and seedling producers are demanded the same requirements as big seed companies.

Indeed, the limitations of the current legislation have already resulted in cases of private misappropriation of landraces, a situation that is even more complicated when the use of landraces names conflicts with other mechanisms of designation of origin, such as the Protected Designation of Origin (PDO) or the Protected Geographical Indication (PGI), created to protect and promote traditional products. A concrete example of the implications of the limitations of the current legislation is the case of the ‘tomàtiga de ramellet’, a tomato landrace cultivated in Mallorca, which is part of the local gastronomic tradition and highly valued by farmers and consumers because they preserve well during the winter^{viii}. In 2010 a fruit and vegetable company wanted to develop a Protected Geographical Indication (PGI) “Tomàtiga de ramellet” with a hybrid variety. In order to protect the traditional name, the regional seed network

‘Associació de Varietats Locals de les Illes Balears’ (member of the RdS) asked the regional government to register the landrace as a “conservation variety”. The case ended with only one ecotype being registered, thus excluding the large variability within the population managed by farmers^{ix}. In 2012 the RdS detected the approval -in the protected variety register- of two tomatoes with landraces names and one with a location name^x.

In the case of landraces knowledge, the governance implications of its digitalization, and specifically whether the initiative will be enough to impede privatization, are still unknown. By making traditional knowledge largely accessible to a community of users who should follow certain management rules, CONECT-e pioneers the digitalization of traditional knowledge under the commons governance framework. This process has many implications regarding the governance and construction/deconstruction of property regimes and the commons (Boyle, 2003) and also many legal implications. On the bright side, the fact that CONECT-e’s content is protected under a Creative Commons License is a big step towards the maintenance of landrace knowledge in the common domain and against its enclosure. In line with initiatives such as the community or people’s biodiversity registers (see Rijal et al., 2000, Gadgil et al., 2000), this type of registration can be seen as a way to account for the “notorious previous existence” of a landrace as it provides an openly available inventory of existing landraces. Being registered in CONECT-e makes varieties non-eligible for formal registration (as regulated by the Law 3/2000). On the dark side, there are no mechanisms in place for cross-checking that varieties that apply for registration in national registers are not already included in CONECT-e or in the IECTBA. The costs of maintaining an observers network that could detect in advance misappropriation processes or of engaging in legal battles when misappropriation is detected

could be too large to be assumed by the organizations developing this project (mainly research and higher education institutions), for which misappropriation might still continue.

6. Conclusion

From the analysis presented here we conclude that a shift in the governance system is necessary to guarantee the *in situ* maintenance of landraces and associated knowledge and to avoid misappropriation. The current legal governance system considers plant genetic resources and associated knowledge should be governed as public or as private goods, but it does not contemplate their governance as a common, a situation that creates important loopholes with concrete consequences for farmers. We argue that there is a need to regulate the common management of landraces and associated knowledge, allowing the three systems to coexist.

The legitimization of common management of landraces and associated knowledge might strengthen common governance and at the same time promote agrobiodiversity conservation. Concrete ways in which this could be done would be by creating alternative registers or inventories for landraces and artisanal seed producers, designed taking into account their specific characteristics; or by establishing different regulations for profit-oriented big seeds companies and for farmers or artisanal seed companies promoting agrobiodiversity conservation. Nested relationships between common and public governance have proved to be successful in governing other resources, such as fisheries or hunter reserves, as they have enabled the community to maintain their artisanal activities and conserving the resource (Berkes et al. 1989). Why not for landraces and associated knowledge as commons?

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References

- ACEITUNO-MATA, L., TARDÍO, J., PARDO DE SANTAYANA, M., BENYEI, P., CALVET-MIR, L. & REYES-GARCÍA, V. La biodiversidad agrícola como bien comunal: problemáticas y estrategias. ICAS Colloquium: El Futuro de la Alimentación y Retos de la Agricultura para el Siglo XXI, 2017 Vitoria.
- BOLLIER, D. & HELFRICH, S. (eds.) 2014. *The wealth of the commons: A world beyond market and state.*, London: Leveellers Press.
- BOYLE, J. 2003. The Second Enclosure Movement and the Construction of the Public Domain. *Law and Contemporary Problems*, 66, 33-74.
- BRUSH, S. B. 2004. *Farmers' Bounty: Locating Crop Diversity in the Contemporary World*, Yale, Yale University Press.
- CALVET-MIR, L., CALVET-MIR, M. & REYES-GARCÍA, V. 2010. Traditional ecological knowledge and landraces in situ conservation in high mountain home gardens of Vall Fosca, Catalan Pyrenees, Iberian Peninsula. In: POCHETTINO, M. L., LADIO, A. H. & ARENAS, P. M. (eds.) *Tradiciones y transformaciones en etnobotánica*. Buenos Aires, Argentina: CYTED.
- CALVET-MIR, L., CALVET-MIR, M., VAQUÉ-NUÑEZ, L. & REYES-GARCÍA, V. 2011. Landraces in situ Conservation: A Case Study in High-Mountain Home Gardens in Vall Fosca, Catalan Pyrenees, Iberian Peninsula. *Economic Botany*, 65, 146-157.
- CASAÑAS, F., SIMÓ, J., CASALS, J. & PROHENS, J. 2017. Toward an Evolved Concept of Landrace. *Frontiers in Plant Science*, 8.
- DE LA ROSA, L. & MARTIN, I. Las colecciones de germoplasma de variedades tradicionales. VIII Congreso de Mejora Genética de Plantas, 2016 Vitoria. Servicio de publicaciones del Gobierno Vasco, 43 - 60.
- DEIBEL, E. 2013. Open Variety Rights: Rethinking the Commodification of Plants. *Journal of Agrarian Change* 13, 282-309.
- FRISCHMANN, B. M., MADISON, M. J. & STRANDBURG, K. J. (eds.) 2014. *Governing Knowledge Commons*, Oxford: Oxford UP.
- GADGIL, M., RAO, P. R. S., UTKARSH, G., PRAMOD, P. & CHHATRE, A. 2000. New meanings for old knowledge: The People's Biodiversity Registers program. *Ecological Applications*, 10, 1307-1317.
- GHIJSEN, H. 2009. Intellectual property rights and access rules for germplasm: benefit or straitjacket? *Euphytica*, 170, 229-234.
- HALEWOOD, M. 2013. What kind of goods are plant genetic resources for food and agriculture? Towards the identification and development of a new global commons. *International Journal of the Commons*, 7.
- HESS, C. & OSTROM, E. (eds.) 2007. *Understanding Knowledge as a Commons. From Theory to Practice*: The MIT Press.
- KLOPPENBURG, J. 2010. Impeding Dispossession, Enabling Repossession: Biological Open Source and the Recovery of Seed Sovereignty. *Journal of Agrarian Change*, 10, 367-388.
- KOSTAKIS, V. 2010. Identifying and understanding the problems of Wikipedia's peer governance: The case of inclusionists versus deletionists. *First Monday*, 15, 1-11.
- KOSTAKIS, V. & BAUWENS, M. 2014. *Network society and future scenarios for a collaborative economy*, Palgrave Macmillan.

- LAKSHMI POORNA, R., MYMOON, M. & HARIHARAN, A. 2014. Preservation and protection of traditional knowledge - diverse documentation initiatives across the globe. *Current Science*, 107, 1240-1246.
- LUBY, C. H., KLOPPENBURG, J., MICHAELS, T. E. & GOLDMAN, I. L. 2015. Enhancing Freedom to Operate for Plant Breeders and Farmers through Open Source Plant Breeding. *Crop Science*, 55, 2481-2488.
- MACKINNON, R. 2012. *Consent of the Networked. The worldwide struggle for Internet freedom*, Basic Books.
- NEGRI, V. 2007. Towards a more comprehensive definition of 'landrace' than currently published. In: DEL GRECO, A., NEGRI, V. & MAXTED, N. (eds.) *Report of a Task Force on On-farm Conservation and Management*. Rome: Bioversity International.
- OGUAMANAM, C. 2009. Documentation and Digitization of Traditional Knowledge and Intangible Cultural Knowledge: Challenges and Prospects In: KONO, T. (ed.) *Intangible Cultural Heritage and Intellectual Property: Cultural Diversity and Sustainable Development*. Antwerp: Intersentia.
- OSTROM, E. 1990. *Governing the Commons. The Evolution of Institutions for Collective Action*. 1281, Cambridge, Cambridge University Press.
- QUILLIGAN, J. B. 2012. Why distinguish common goods from public goods? In: BOLLIER, D. & HELFRICH, S. (eds.) *The Wealth of the Commons: A World Beyond Market & State*. Amherst: Levellers Press.
- REYES-GARCÍA, V., BENYELI, P. & CALVET-MIR, L. 2017. The common nature of Traditional Agricultural Knowledge. In: VIVERO POL, J. L., FERRANDO, T., DE SCHUTTER, O. & MATTEI, U. (eds.) *Routledge Handbook of Food as a Commons*. Routledge.
- RIJAL, D., RANA, R., SUBEDI, A. & STHAPIT, B. 2000. Adding value to landraces: Community-based approaches for in situ conservation of plant genetic resources in Nepal. In: FRISS-HANSEN, E. & STHAPIT, B. (eds.) *Participatory approaches to the conservation and use of plant genetic resources*. Rome: IPGRI.
- RED DE SEMILLAS. 2015. Spain: the seed network, Resembrando e Intercambiando. In: VERNOOY, R., SHRESTHA, P. & STHAPIT, B. (eds.) *Community Seed Banks. Origins, Evolution and Prospects*. Taylor & Francis.
- SHIVA, V. 2004. Trips, Human Rights and the Public Domain. *The Journal of World Intellectual Property*, 7, 665-673.
- SMALE, M., BELLON, M. R., JARVIS, D. & STHAPIT, B. 2004. Economic concepts for designing policies to conserve crop genetic resources on farms. *Genetic Resources and Crop Evolution*, 51, 121-135.
- THOMAS, M., DAWSON, J. C., GOLDRINGER, I. & BONNEUIL, C. 2011. Seed exchanges, a key to analyze crop diversity dynamics in farmer-led on-farm conservation. *Genetic Resources and Crop Evolution*, 58, 321-338.
- WHITT, L. A. 1998. Biocolonialism and the commodification of knowledge. *Science as culture*, 7, 33-67.

ⁱ BOE (2006). Ley 30/2006, de 26 de julio, de semillas y plantas de vivero y de recursos fitogenéticos (BOE núm. 178, de 27-07-2006). <http://www.boe.es/boe/dias/2006/07/27/pdfs/A28165-28178.pdf>

ⁱⁱ https://www.boe.es/diario_boe/txt.php?id=BOE-A-2017-2990

ⁱⁱⁱ https://ec.europa.eu/food/plant/plant_propagation_material_en

^{iv} https://ec.europa.eu/food/sites/food/files/plant/docs/ppm_legis_review_11820_sum.pdf

^v <http://www.mapama.gob.es/es/agricultura/temas/medios-de-produccion/semillas-y-plantas-de-vivero/registro-de-variedades/reg-de-variedades-protégidas/>

^{vi} The group includes more than 80 researchers from different disciplines (i.e., agronomists, botanists, anthropologists and linguists) belonging to more than 20 research centres, universities and non-governmental organizations.

^{vii} DIVERSIFOOD Innovation Factsheet #1 – Community Seed Banks (2017). http://www.diversifood.eu/wp-content/uploads/2016/04/Diversifood_innovation_factsheet1_CSB.pdf

^{viii} Carrascosa, M (2016). Preparatory action on EU plant and animal genetic resources. Valorisation of hanging tomatoes in Spain: http://www.geneticresources.eu/wp-content/uploads/2016/07/8_ES_Valorisation-of-hanging-tomatoes.pdf

^{ix} <http://www.mapama.gob.es/app/regVar/DetalleVariedad.aspx?id=es&TipoV=C&IDVariedad=20100178>

^x See Orden AAA/1403/2012, June 18. BOE núm. 154, de 28-06-2012.

<https://www.boe.es/boe/dias/2012/06/28/pdfs/BOE-A-2012-8661.pdf> and Red de Semillas “Resembrando e Intercambiando” y Xarxa Catalana de Graners (2015). Comunicado de prensa “La DOP Ganxet provoca erosión genética y limita los derechos de los agricultores”: <http://www.redsemillas.info/dop-ganxet-provoca-erosion-genetica-limita-derechos-agricultores/>