Feeding the future: the critical role of seeds in food systems and cultural heritage

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Keywords: seeds, genetic resources, agri-food systems, local food

Abstract. Genetic resources constitute a critical resource to deal with the current climatic and geostrategic challenges. The XXI century reintroduced the problem of food security in political and scientific agendas of developed countries. At the roots of this re-emergence are multidimensional reasons: economic (cereals crisis in 2008), public health (covid pandemic), and war (Russia vs Ukraine). Within this context, the reflection on basic issues concerning the food system, namely food production and the resources involved in, such as seeds, is of utmost importance. The paper presents an exploratory approach to genetic conservation through banks in Portugal. The sections of the paper include a problematization, namely the international and national framework on the subject, the design of an analytical model, and the presentation of the results of a case study of a Portuguese genetic bank.

Introduction

The XXI century reintroduced the problem of food crisis in the political and scientific agendas of developed countries. In fact, and besides the inflation of cereals prices in 2008, the pandemic of Covid 19, and, more recently, the war between Russia and Ukraine, provoked the re-emergence of the problem of food security. Nowadays the expression 'food crisis' appears in daily news. The paper presents a reflection on the issue of seeds, considering the case of a genetic bank in Portugal, Banco Português de Germplasma Vegetal (BPGV). The main goals of the research are the design of an analytical approach to this resource considering, and among other aspects, the legal framework, in European and national terms, the actors involved, and the main challenges faced by those initiatives. With this purpose in mind, the paper is organized in the following sections: after the presentation of the methods and resources used in the research, the theoretical framework and operational concepts are identified through a problematic approach. The results of the research correspond to the next section. Finally, some conclusions are presented.

Methods and sources

The research on genetic banks used secondary and primary data. Secondary data was obtained through reports and other publications on the subject, namely online resources; primary data was obtained through interviews to key actors in the field, namely those responsible by the genetic bank selected as case study, that is, BPGV. This is an exploratory and qualitative approach to the subject. Within this approach it is proposed an analytical framework through the identification of some critical dimensions in the understanding of this initiatives, namely the political and institutional framework of these banks, their methodology towards genetic preservation (*in-situ*, ex-situ), and legal nature. The main challenges faced by these banks constitute an important step of this exploratory approach.

Theoretical framework and operational concepts

The approach to seeds and the constitution of genetic banks in developed countries should be approached through the concept of food security. This concept known an evolution through time. Food crisis between 2005 and 2008 changed the social perception of agriculture and the problems of land use (Larsson, 2010). The concept of food security has evolved and nowadays presents a multidimensional, global, and complex nature of the relationship of current societies with food (Mattas et al, 2018), something presented as "scarcity in abundance": overconsumption and waste on the one hand, hunger and death from lack of food, on the other hand (Rovati and Campiglio 2009). The book *Poverty and Famines* by Amartya Sen (1982) made a decisive contribution to this debate by placing the problem of food security in the analytical context of economics, beyond the humanitarian sphere (ibid.). At the World Food Summit in 1996 food security was defined as the condition in which all people have physical and economic access to sufficient, safe, and nutritious food and that meets dietary needs and preferences for an active and healthy life (Mattas et al, 2018, p.4). This change involves a shift of perspective on the problem of food, considering, among other aspects, the access, quality poverty reduction, social inclusion, and environmental sustainability (Id., p.6). Food production, namely agriculture, has an enormous ecological and environmental impact, including biodiversity loss. Because of the Green Revolution of the 1960', with the intensive use of natural resources and chemical inputs, "alarm was voiced" at FAO (Khoury et al, 2022, p.84). This was the context where was coined the term 'genetic erosion', "to describe this dramatic loss of genetic resources" (Id. ibid). The conservation of seeds, namely through genebanks, correspond to a critical resource within this problem. The maintenance

of genetic diversity of crops through genebanks has been promoted by different institutions and initiatives through the time. This is the case of the International Board for Plant Genetic Resources (IBPGR), established in 1974 (Khoury et al, 2022, p.85). This board "supported the collecting of over 200 000 samples of landraces, crop wild relatives and other genetic resources in 136 countries between 1975 and 1995, and helped established international genebank collections to maintain these samples" (Thorman et al., 2019, cit in Id. Ibid.). Other milestones in genetic conservation include the creation, in 1980, of the European Program for Genetic Resources (ECPGR); the Commission on Plant Genetic Resources, created by FAO in 1983; the Convention on Biologic Diversity as a result of the UN Rio Conference (1992); in 1994 was established the International Network of *ex situ* collections (with approximately 450,000 accessions worldwide) (Thorman et al., 2019, p. 10); in 1996 it was established the Global Action Plan for Conservation and Sustainable Use of Vegetable Genetic Resources for Food and Agriculture; the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in 2001 (in force since June 2004) (id.). This International Treaty was at the base of other initiatives, such as the Nagoya Protocol, and has the following goals: guarantee food security though conservation, exchange, and sustainable use of vegetable genetic resources; creation of a multilateral system of access to those resources; establish the rights of farmers in terms of access and share of benefits resulting from the use of those resources. Property rights, namely intellectual property rights, are also central in the debate on genetic banks and biodiversity protection. The industrialization of agricultural production has required a strong harmonization of rules and procedures in the marketing and sale of seeds. The development of large production companies and the allocation of property rights under the guise of quality in plant health requirements has produced rules concerning the commercial breeding of seeds and favoured genetically distinct, homogenous, and stable (D.H.E) varieties in production (Prip & Fauchald, 2016, p. 363). Most of the Portuguese legislation on this subject is the result of the transposition of EU legislation into the national legal framework. The two central requirements in the European seed directives concern the registration of varieties and their batch certification. The registration requirement means that to be produced, marketed, and exchanged in the EU, a plant variety must be entered in the National Catalogue of Varieties (CNV) and, depending on the species, in the EU Common Catalogue. To be registered in the CNV and to obtain breeder's rights (exclusivity of production and commercialization of the varieties obtained, and of all the corresponding reproduction or multiplication material) agricultural varieties (crops with industrial application of large, cultivated areas) must meet the DHE and agronomic and use value (VAU) criteria (Law nº. 42/2017, 2017). This legislation establishes a complex web of homogenizing requirements that is inappropriate for the diversity if the agricultural sector. Since the legal criteria have associated costs (of certification and registration), industrial agriculture and large market players are arguably favoured (at the expense of biodiversity loss) while traditional farming systems are harmed, leaving farmers few opportunities to save, use, exchange and sell seeds. The existing rules favour uniformity and the productivist paradigm in detriment of plant diversity, the environment, and the multiplicity of actors. This is aggravated since traditional, small-scale farming, systems are widespread in Europe and are of great importance for local food supply (Prip & Fauchald, 2016, p. 363), providing healthier and more environmentally sustainable food (Barata and Lopes, 2019, p. 3). The theoretical, conceptual, and legal aspects mentioned so far introduce important insights in the problematic of food security and genetic banks, allowing the design of an exploratory analytical approach to the subject. This analytical framework considers international and national public on genetic banks; the approaches *in sity* and *ex situ* adopted by those banks to conservation purposes; the public or private nature of these initiatives; the strategy of valorisation of those resources (e.g. networks, preservation of regional and national diets, development of organic production). (table 1).

Table 1 – genetic banks: analytical framework

public policies		**methodology**		**public/private sector**	**valorisation strategy**
national	international	*in-situ*	*ex-situ*	public private Non-profit/social and solidarity economy/community based	networks territory/local products regional and national diets organic production
Genetic banks: emergence, working, challenges					

Results

In Portugal the institutional framework for genetic resources conservation started in the 1970'. However, the actions of conservation started earlier with the adoption of improvement processes in some regions (p.e. Elvas), which allowed the constitution of germplasm collections in the 1940' and 1950' (MAM, 2015). However, the 1970' correspond to the milestone in the establishment of programs included in the large Program of Genetic Resources for the Mediterranean Region, supported by FAO, namely the Mediterranean Bank of Corn, founded in Braga in 1977. This bank was the first step of the current Portuguese Bank of Vegetable Germplasm, located in the same place. The institutional framework of the subject also includes some legal tools, such as the Law 118/2002, defining the registration, conservation, legal protection, and transference of vegetable

material with interest for agro, agro-forest, and landscape; and the Law 18/2014, establishing norms on the conservation and valorization of vegetable genetic resources. More recently, it should be mentioned the National Plan for Plant Genetic Resources (PNRGV) 2015-2025, created by the National Institute for Agricultural and Veterinary Research, Directorate General for Agriculture and Rural Development, and the Directorate-General for Food and Veterinary. This plan aims the conservation, safeguarding, evaluation, valorization and promotion of agricultural products in the European and world context (MAM, 2015). Like other European countries, Portugal signed the ITPGRFA, and is member of the ECPGR since the creation (1980). Regarding ITPGRFA, Portugal established some compromises, namely the design and implementation of public policies aiming the conservation of genetic resources *ex-situ* and *in situ*, as well as the strengthening of programs of genetic improvement. In this last case the participation of farmers in selection of varieties more adapted to local agricultural systems (MAM, 2015) is a central aspect. In this exploratory exercise, and regarding public policies, it is also important to mention European common public policies such as Common Agricultural Policy, the Biodiversity Strategy, and the Farm to Fork Strategy. These are interrelated public policy measures that concur to the broader political program European Green Deal. The Portuguese Bank of Vegetable Germplasm, located in Braga and established in the 1970', as previously mentioned, corresponds to the selected case of genetic conservation, that is, genetic banks, in this exploratory approach. This is a public bank, and, according, to online information, is one of the worldwide genetic with a collection of more than 47 000 samples of 150 species and 90 types of cereals, medicinal and aromatic plants, and other vegetable resources. It contains the second world collection of corn, and one of the 170 world banks with more than 10 000 conserved varieties, in the top 10% (https://www.iniav.pt/bpgv). Through a material transfer agreement (MTA), the bank can provide seeds (no more than 20 units) to interested farmers (who multiply and return them in equal numbers). Most of these farmers are young people looking for traditional seeds, a situation that represents an exception in the Portuguese seed market. The sale and exchange of seeds takes place within a political context of tension between the need for harmonization of standards (based on the industrialization of agricultural production) and the need for flexibility and adaptability (conservation and use of crop genetic diversity) (Prip & Fauchald, 2016, p. 363). There is a significant contradiction in the consequent genetic erosion resulting from the harmful action of modern production systems vis-à-vis traditional ones, on which the former entirety depends. The need for crop genetic diversity does not fit into the logic of harmonization. Food security results from conservation, exchange, and the social-ecological approach to agrobiodiversity and its constituent genetic resources. Crop biodiversity provides the basis of agriculture and determines its capacity in the face of growing demand for healthy food and climate emergence, being therefore crucial for the adaptability of agricultural crops. The high genetic diversity and wide range of traditional varieties are precisely what prevents them from being able to meet the DHE and VAU criteria and, interestingly, what gives them the greatest climatic adaptability and nutritional richness. The obligation to comply with strict standards in seed production and marketing seems to protect farmers' rights and public health but in fact is contradictorily going the opposite way. And while the 2018 European organic farming regulation authorizes the free production, exchange, and sale of local and traditional seeds without the requirement to register with the CNV, they can only be produced in their region of origin and in extremely limited quantities. Recently, the Regulation (EU) Nº 2018/848 on organic production and labelling of organic products, includes an important victory for farmers, small seed multipliers and guardians of local/traditional seed, as the free production, exchange and sale of local/traditional/peasant seed is allowed, without the obligation to register in the CNV. However, the European Commission is trying to pass a so-called 'delegated act' that again restricts the market for non-commercial seed. Since its implementation, seed legislation has gained relevance. Its vague and contradictory outlines have caught the attention of various civil society groups that for years on end have campaigned for equitable access to seeds that provide healthy food and ecological farming practices (https://gaia.org.pt/sementeslivres/). These political, legal, and institutional factors impact how farmers manage, conserve and access to agrobiodiversity (Dullo et al., 2017, p. 108). Besides those aspects regarding the specificities and contradictions of the legal framework on seed conservation, it is possible to add some problems faced by the Portuguese genebanks, namely the case under analysis. According to secondary and primary (interview) data on the bank, the main problems and challenges are the following: financial problems with consequences in other important resources, such as human resources involved in the management of the bank; the need to integrate the genetic information in a common platform; the absence of common references regarding the concepts, language and methodologies of reference for the conservation of vegetable genetic resources; the different and eventually overlapping political responsibility of the bank (Ministry of the Environment, and Ministry of Agriculture); the need to update the legislation on the sector.

Conclusions

The exploratory approach to seeds and genetic banks in Portugal gives light to some important aspects on the subject. This is the case of the complex and limitative nature of the legal framework, giving place to the harmonization of diversity, a paradox situation in line with the produtivist model. In Portugal the genetic conservation processes started in the middle of the XX century with important progresses since the 1970'. Like other European countries, Portugal adopted important international commitments and established conservation infrastructures. This is the case of the Portuguese Bank of Vegetable Germplasm, a public genetic conservation

infrastructure, with relevant collections, namely corn. The challenges of this bank are mostly related with financial resources, but also institutional aspects, such as the law and the political framework.

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