

From Seed to Bread : Co-construction of a Cereal Seed Network in Wallonia

Baltazar S.¹, Visser M.², Dendoncker N.¹

¹ *Université de Namur (UNamur), Department of Geography; 61, Rue de Bruxelles, 5000 Namur, Belgium. Sofia.baltazar@unamur.be ; Nicolas.dendoncker@unamur.be*

² *Université Libre de Bruxelles (ULB), Interfaculty School of Bio-engineers, Unit of Landscape Ecology and Plant Production Systems ; CP 264/2, Av. F. Roosevelt 50, B-1050 Brussels, Belgium ; marjolein.visser@ulb.ac.be*

Keywords: Seed network, participation, co-construction, agroecology, bread, cereals, Wallonia.

Abstract (250 words)

After losing its artisan character after World War II, bread is now commoditized as the outcome of an increasingly globalised seed, cereal growing, milling and baking industry. Yet, alternative pathways are emerging to develop a more resilient and locally-adapted cereal system. Our case study focuses on exploring the emergence of a cereal seed network in Wallonia, which gathers farmers, millers, bakers, households and researchers. In this paper we look into the creative process of co-construction of this network, after 3 years of participant observation. We explore how group objectives and personal motivations evolved along with internal and external events. The main objective of this network is to conserve and breed a diversity of cereal varieties adapted to local agroecological food systems. Our results show that (i) novelties are being produced and tested in farms; (ii) opening up a safe-learning space favours networking of these isolated novel actors; (iii) collaborative management of cultivated diversity entails opportunities and challenges. We discuss these results in the light of similar experiences of seed networks in Europe and outline questions raised by challenges faced in participatory research on seed. Our conclusions suggest that in order to improve the nutritional quality of bread and develop a more resilient cereal system, collective management of seed and participatory plant breeding programs should be fostered. This will need a reversal of agronomy research approaches and of priorities in food policy.

1. Introduction

From seed to bread: consequences of the modernisation of the cereal system

In Europe, the post-World War II food system established firstly a formal seed system creating pure-line standardized varieties that gradually substituted landraces and excluded farmers' seed selection practices and knowledge. Another consequence of this evolution was the continuous decline of cultivated diversity, both inter- and intra-specific, resulting in genetic erosion (Bonnin *et al.*, 2014). Losing cultivated diversity also involves losing associated knowledge, which can be termed as cultural erosion (Vára-Sanchez and Cuellar-Padilla, 2013). This loss in genetic and cultural diversity reduces options for adapting to changing conditions and thus threatens the resilience of farming systems (Hajjar *et al.*, 2008). Because low-input farming has to adapt to greater environmental variability than high-input farming, it needs heterogeneous varieties that have a capacity to evolve and adapt to these changes (Rivière *et al.*, 2013). Yet today most organic and agroecological farmers sow pure-line (homogeneous) varieties bred for high-external input farming, which are inadequate in the light of the challenges they face (Bueren and van Myers, 2012).

Farmers are not the only actors of the food chain affected by changes in the cereal seed system. Although modern wheat breeding enabled substantial yield gains, almost unilateral focus on this criterion led to

downside effects such as decrease of mineral density or selection of a type of gluten, which may produce non-coeliac hypersensitivity. Changes downstream also impacted bread quality: industrial milling and baking practices have favoured white airy bread, with high salt content and low nutritional value, based on standardised flour mixes from cylinder-type mills. In classic bakery training programs, students no longer learn to bake with sourdough or without flour additives (Rémésy *et al.*, 2015).

Emerging alternative networks and accompanying research

The global food system is in crisis but due to mechanisms related to path dependency and lock-in, promising alternative pathways towards sustainability struggle to gain legitimacy (Sutherland *et al.*, 2012). Nevertheless, some of these pathways are gaining momentum. On the farmer's side, a groundswell of change is driven by a quest for more autonomy, through better use of internal resources and lesser reliance on global markets. On the households' side, a similar change is driven by a desire to reconnect with the land, find local food of better nutritional quality etc. Both sides are connected through the process of repeasantisation and the emergence of novel food markets linking farmers directly to households (van der Ploeg, 2008).

Institutional and research discourses (and practices) are also shifting. Participatory approaches are now acknowledged as an asset to foster innovation. Still there are various types of participation ranging from passive participation to more active forms like self-mobilisation. In more passive forms, the first-concerned actors are not included in co-producing knowledge or in decision-making. Active forms of participation rather try to enhance the skills of rural actors and encourage them to develop and promote their own processes (Cuellar-Padilla and Calle-Collado, 2011). This is the type of participation adopted for example by agroecology, in which we ground our research approach. We refer here to the specific concept of agroecology, defined as an intermediary action concept at the crossroads of science, practice and social movements (Wezel *et al.* 2009; Stassart *et al.*, 2012). Agroecology seeks to establish a "dialogue of knowledge", which Rosset and Martinez-Torres (2014) summarised as a "*dialogue among different knowledge and ways of knowing*" which can "*form the basis for construction of new processes*". Other research traditions fuelled the debate on participation, like Farming Systems Research (Darnhofer *et al.*, 2012) or Participatory Action Research (Reason *et al.*; 2006).

Regarding the seed question, numerous authors underpin the importance of farmers' contribution to the management of cultivated diversity (e.g. Osman and Chable, 2009; Pautasso *et al.*, 2013). Technical and social innovations appeared over the last 20 years – e.g. on-farm evolutionary plant breeding (a method based on genetic diversity and natural selection to develop locally adapted populations) (Döring *et al.*, 2011) or participatory plant breeding (PPB). PPB can be defined as the participation of several actors (farmers, consumers, researchers...) in the breeding process and is based on the complementarity of knowledge and know-how of each participant (Cecarelli, 2012). Rivièrè *et al.* (2013) suggest a methodology for co-constructing a PPB project between farmers, local organisations and researchers: each step is collectively defined and evaluated. They outline that co-construction demands time and trust-building.

Aforementioned scientific and societal issues can also be found in the Belgian research and extension landscape, where until today alternative pathways for managing cultivated diversity remain hidden. Very little research has been carried out to understand and appreciate the dynamics, motivations, knowledge and strategies of farmers (and their networks) regarding varietal innovation within the cereal system. To our assumption, this should be the first step when co-constructing any participatory research project (e.g. PPB) and to develop a sustainable and locally adapted cereal system in Belgium. Therefore we wish to contribute to the debate on the elements needed while conducting research that seeks to understand and support alternative pathways laid out by food networks.

We do so in this paper by looking into the creative process that led to the emergence of a cereal seed network in Wallonia. We also provide some first reflexive thoughts on our role as researchers in this process. First we briefly explain the method used to analyse the co-construction and explicit our role. Second we present results about the trajectory of the network. We then discuss main outcomes, key challenges and questions they raise. Finally we conclude with some perspectives on changes needed in order to foster innovation throughout the cereal system.

2. Case Study and method

In Wallonia, although cereals are the second most important crop in terms of land area (wheat representing 70% of cultivated cereals), bread wheat cropping declined to the point where most farmers grow low-quality forage wheat¹ and most bread grain is imported for an increasingly large-scale and globalised bread baking industry (Delcour *et al.*, 2012). Within this context, different actors of the cereal system are reclaiming an active role in defining seed and bread quality (Louah *et al.*, 2015)

Field research started in 2013 by carrying participant observation in farms developing alternative pathways for bread wheat seed, in southern (Gaume) and western (Hainaut) Wallonia. From then on we participated in all meetings and activities of the emerging network (Table 1), which evolution is described in the results section. As the network grew and consolidated, our research approach evolved alongside and became more action-oriented in order to co-construct this regional seed network.

Grounded in agroecological participatory approaches we look as much on the improvement of the situation as on the process for this improvement. In this paper we focus on the process itself. We conducted a content analysis on meeting reports, notes taken throughout the whole process (group and individual meetings, field trips, workshops etc.) and e-mail exchanges. This enabled us to build a narrative of the trajectory from isolated individual initiatives to the emergence of the network. We then draw on the framework developed by Combette *et al.* (2015) to illustrate the history of collectives working on cultivated diversity in France, adapting it to our case study. We used a timeline (table 1) to organize data in order to visualize the chronology of the process and show that the networks' functioning and activities are continuously evolving. We synthesized and classified data in five categories: group objectives, internal events, evolution of the core group, individual motivations and reflexion, external events. Lastly we focused on examining challenges faced in regard of the growing dimension of the network and questions raised, in the light of scientific literature.

3. Results

Varietal novelties are being produced in distinct farms.

While carrying participant observation in farms developing alternative pathways for bread wheat seed, we identified two distinct local initiatives. Benjamin² is a farmer-miller from southern Wallonia (Gaume). Among other experiments, he takes part in a French participatory plant breeding (PPB) program, which developed an innovative methodology for on-farm breeding (Rivière *et al.*, 2013) in response to the demand of farmer-bakers from the Réseau Semences Paysannes (RSP, French seed network). Benjamin's motivation is to develop bread wheat peasant populations adapted to his "*terroir*"³ and artisan bakery. On his farm, seed-related work is collective. It is both a political choice and a necessity in order to overcome the big amount of work to be done: sowing, harvesting, threshing and seed cleaning and sorting. These collective action

¹ As it is easier to obtain high yields and less risky, farmers generally prefer to sow varieties destined to become animal feed or to produce biogas.

² This fictitious name is used in order to preserve anonymity of participants.

³ Not translatable French word for local land.

moments are also an opportunity to exchange seed, knowledge and know-how. A supportive group of “eaters” helps with work organization.

At the same time at the other end of Wallonia (Hainaut, Western Belgium), other farmers were also reflecting on agroecological solutions for production and processing of cereals. They gathered together in a very local network of “outsiders” to the agroindustrial modernization project: the “*Réseau des fermes novatrices*” (RFN) which means “innovative farms’ network”. They spontaneously chose to change their practices and establish new relations with other spaces (consumer groups, schools, restaurants...), thus producing novelties (Louah *et al.* 2015). Among other subjects, they started working together on bread cereals and were particularly interested in testing old as well as modern population varieties of cereals (e.g. the Composite Cross Populations developed by the Organic Research Centre in the UK). This dynamic group organised meetings and field trips to foster exchanges between them but also with other rural actors and researchers. Their will is to develop new partnerships with scientists (in particular agronomists) that radically differ from the most common linear knowledge transfer model.

Due primarily to geographical distance, these local initiatives were evolving in parallel, with few contacts with each other.

Isolated initiatives join into a regional cereal seed network.

Farmer-researcher interactions played a key role in triggering a regional network dynamics. Concomitantly to the start of this PhD research project, a growing interest in traditional varieties was arising from actors of the non-industrial cereal chain. People who came to help Benjamin with seed-related work started going back to their farms and gardens with a bag of seed from his population of landraces. They started calling themselves “ancient wheat sowers”. In the autumn of 2013 we suggested structuring a learning group gathering farmers (4), millers (2), bakers (2) and gardeners/consumers (3) from the South-East of Wallonia. The aim was to create a space for knowledge sharing and collaborative learning “from seed to bread” between “ancient wheat sowers” as well as other stakeholders.

This group progressively expanded and transformed into a cereal seed network (today with 82 members) that aims at reconnecting stakeholders from the non-industrial cereal chain and collectively reclaim seed sovereignty. One of the turning points happened in November 2014 when Benjamin induced a meeting between the researcher and two bakers willing to spend time on the seed question in cereals, particularly by favouring knowledge exchange and networking farmers and bakers. The agreement was to start first with a core group that would set a basis for a future network, and secondly to broaden it to actors interested in joining in. A series of observations and objectives were co-defined. The time was judged right to provoke a first wider meeting to confront these to other identified actors.

Thus the networks’ launch meeting was held at the beginning of January 2015. The main criteria for participant selection was trust, guaranteed by peer recommendation. There was also a will to have a strong representation of farmers, thus efforts were made to personally contact potentially interested ones. Mostly bakers came and this has proven to be a continuous challenge throughout the process: while a lot of farmers claim to be very interested in the subject, time is clearly a constraint to their active participation in meetings and group dynamics in general. Bakers, however, generally have more time and it is only one of the few reasons why this collaboration between stakeholders can be so interesting and fruitful. A series of observations were shared with participants as a starting point. These were mainly (i) local initiatives are emerging, from farmer to baker, to develop a non-industrial cereal system, but they are disconnected; (ii) interest in other varieties (landraces, populations, ancient species) is rising but faces the challenge of learning (forgotten or new) knowledge and practices. Participants were then asked to present themselves, their **individual reflexions and motivations** regarding the network and whether they agreed with the observations made. All of them agreed but some debated the need to formalise a structure, which involves

a substantial part of administrative work. It was also noted that initial **group objectives** were very large (Table 1). Thus it was agreed to start with concrete actions, which would create knowledge exchange opportunities, but also enable actors to get to know each other. This would also nourish further reflexion to progressively refine group objectives. In order to do that, simple communication tools were to be created. Finally it was stated that this regional network does not substitute local initiatives and networks, rather it is complementary. Later a name was decided for the network: *Li Mestère*, meaning in Walloon dialect a mixed cereal crop, often wheat and rye.

Among actions undertaken until now (**internal events**) are farm, mill and bakery visits, experience-sharing meetings, technical and practical workshops on sourdough breadmaking, wheat landraces selection criteria etc. In 2015, after searching several public and associative seed banks for material, *in-situ* collections of wheat, spelt and oat landraces were set-up in several locations of Wallonia. *Li Mestère* also became a member of the Réseau Semences Paysannes (France). This allowed 6 farmers and 3 gardeners to participate in the French PPB program (with the RSP and INRA-Le Moulon) and thus getting familiar with its technical and organisational aspects (Table 1).

External events (Table 1) have also stimulated individual and group motivations and reflexions. These include seminars, workshops, field trips organised by other actors (e.g. other farmers' associations), but also national and international networking of seed initiatives (not only cereal, but also vegetable seed). In parallel, biannual network meetings were times to refine and prioritise **group objectives** (Table 1). In September 2015, 3 short-term objectives were identified: (i) favour better access to information and technical training (conservation and breeding, cropping, milling, baking); (ii) set-up a dynamic *in-situ* collection of wheat, spelt and oat landraces (in several locations); (iii) consolidate the PPB project. Long-term objectives (communication and awareness raising, legal and political support) are to be addressed in a second time according to the process' evolution.

The **evolution of the core group** (Table 1) was parallel to the objectives' refinement. Until recently, the original driving force (two bakers and a researcher) assumed secretary tasks and co-facilitation. They also co-constructed information and communication tools to support group objectives: mailing list, shared file storage, flyer; training material (technical forms). The network is at a new turning point, where it seeks to evolve into a more horizontal structure: for each priority objectives 2 or 3 persons are responsible for its operational framework and implement. Again it raises the question of whether it should formalise a legal structure in order to appoint a group facilitator.

In the co-construction process presented here, we are both researchers and participants. This increases even more the need for reflexive thinking on our role in this process. As researchers, our role relies in 3 specific contributions within the core group:

- (i) Providing technical support for optimizing practices of in-situ dynamic management of cultivated diversity (e.g.: giving advice on how to sow and manage experimental microplots; to best conserve seed...);
- (ii) Supporting the learning process in order to foster emergence of conditions for knowledge exchange and production. A significant part of our time is dedicated to creating a safe-learning space and co-facilitate the network's life and activities: organisation and facilitation of meetings, field visits, training; maintain personal contacts with members; connect with other associations/networks etc.;
- (iii) Understanding the learning process: assessing learning outcomes from the content (of the process) and the process itself.

The emergence of the network was favoured by our involvement and expertise, but co-construction was made possible by the already latent dynamic – in other words, the timing was right

Table 1 - Co-construction of Li Mestère, a cereal seed network in Wallonia (Belgium)

Group objectives	Internal Events	Evolution of core group	Time	Individual motivations and reflexions	External events
	Collective harvest and threshing of on-farm wheat trials "From Bread to wheat" on-farm workshops	Informal group of ancient wheat sowers	2013	What is a good wheat? How to breed it? Political act to spread seed Bakers' acknowledgement of cereal quality Collaborate with research	Participatory film on wheat landraces PhD start – participant observation
Link farmers and bakers around seed through knowledge sharing Better cereal and bread quality Fair commercial relations between actors	"Ancient wheat sowers tour" Collective harvest of on-farm wheat trials Experience and knowledge sharing meeting" Pre-definition of group objectives, identification of stakeholders and pre-selection of participants for potential network	Informal group of ancient wheat sowers and RFN 2 bakers + 1 researcher	2014	Find varieties adapted to "terroir" and test best practices Knowledge on landraces and populations Multiply "seed that matters" Find processing and marketing outlets Peasant-baker status recognition Concrete change happening	PPB seminar in France ECVC seed workshop in Brussels RFN farm visit
Create knowledge exchange opportunities Better access to information Technical training Set-up of seed collection Consolidate PPB dynamic Find varieties adapted to farmers and bakers	Network creation and objectives refinement Sourdough bread workshops Field visit Study trip to North of France (on PPB) RSP membership Peasant Cereals Feast (workshops and seed exchange) Network meeting: update of objectives Seed prospecting and collection set-up 9 members engage in PPB program (national and pre-sowing meetings) Development of communication tools	2 bakers + 1 researcher	2015	(Need for) structuring network – divergence of views on how Need to expand core group	"Agroecology in Action" – mill visit and experience sharing workshop in Flanders 2 watermill takeovers On-farm experiment on SWI (with INAGRO)
Map initiatives and needs Networking (other actors) Long term: awareness raising; legal and political support	Network meetings (detail subtasks) Workshops on sourdough and landraces Study trip to South of France (PPB, gluten) Field visits (collections & PPB)	2 volunteers for each one of the 3 priority themes	2016	More training on criteria for choosing landraces	MAP work on alternative bread sector Coordination of seed initiatives in Benelux

Collaborative management of cultivated diversity entails opportunities and challenges

Today *Li Mestère* remains an informal cereal seed network but gathers around about 82 farmers, bakers, millers, gardeners, citizens and researchers. Within this bread cereals renewal and accompanying research, a collective management of cultivated diversity is arising. Field trips, meetings and workshops allowed to strengthen interactions between actors, intensify seed and knowledge exchanges (between practitioners as well as between the researcher and them), foster on-farm experiments and initiate co-construction of a collaborative research. Finding seed to start this process also required collaborating with others: *ex-situ* seed banks but also existing groups or seed networks. A couple of French associations that maintain collections of landraces helped *Li Mestère* by providing seed samples (in larger amounts than seed banks).

Networking also made visible hidden novelties being produced on-farm that are orphaned by conventional agronomy research and extension. Some of these novelties tackle problems at the food system level. For example, a young farmer created the first Community Supported Agriculture system adapted to cereals in Belgium, experimenting in this field also a social and solidarity economy. Other farmers test novel farming practices. Regarding wheat cropping, one innovative agroecological practice which comes to the fore is the System of Wheat Intensification (SWI). Several farmers of *Li Mestère* are testing it at the moment. We are co-constructing research with them to assess the potential of these innovative practices, in the light of objectives collectively defined inside the network but also within this parallel collaboration (Table 2).

Table 2 - The System of Wheat Intensification : an innovative wheat cropping practice

The System of Wheat Intensification is called after the System of Rice Intensification (SRI), which was discovered in Madagascar and first described in 2002 only. Since then, farmers and researchers have begun adapting and extrapolating its principles to a range of other crops, so that we can now speak of a general system of crop intensification (SCI) (Abraham *et al.*, 2014). SRI has been reassessed while insisting on aspects of basic plant husbandry and soil life, challenging a series of blind spots of the mainstream agronomy and plant breeding that underpinned the Green Revolution. In a nutshell, the SWI consists of a set of interrelated practices based on considerably reduced seeding density to lower intra-crop competition (from the conventional 150-200 kg/ha to 20-40 kg/ha). Together, these practices work synergetically, stimulating intensive tillering, maximal ear development and minimal tiller death. In all, individual plant vigour and total grain yield are improved with minimal cost or external inputs, therefore addressing the need for ecological (re)intensification and having a positive impact on farm autonomy. Interestingly, the low densities also change the phenotypic expression of the genotype, which has huge consequences for plant breeding. Some (conventional) plant breeders challenge now the standard practice of high seeding density in wheat that became entrenched during the twentieth century as there is a trade-off between yield potential (through tillering) and competitive ability. The question is then obviously: what if this practice is combined with evolutionary breeding? Can the local adaptation process of populations be enhanced through selection within an SWI environment? In order to explore this, a master thesis student is carrying an on-farm experiment. In this trial we compare how a pure-line vs. a population behave under SWI vs “normal” density (following the farmer’s usual practices). This work also includes a survey of farmers practising different variants of this system.

This encouraging rapid growth of this network broadens out the realm of the possible but also raises new challenges and *in fine* questions to be examined. Two main challenges are currently being experienced within the network. The first one is linked to legal issues. From the beginning, the question of (il)legality was raised. Formalising a network means at the same time enhancing visibility of “hidden” practices (thus exposing members) and creating a strong solidarity web (reaction and claim power). It is also a means to legitimise the existence and purpose of these practices. Yet recent evolution of (inter)national legal

frameworks and seed property rights jurisprudence have enhanced concerns on farmers' rights in general, and in particular related to seed sovereignty. This situation maintains distrust regarding collaboration with research or private seed industry or even seed artisans, fearing predominance of individual or commercial interests, or even biopiracy. This brings forward the question of how to collectively define and agree upon rules for the use and circulation of seed. The second main challenge faced today by the network is its long-term durability perspectives. Indeed it could be hindered because of the voluntary nature of most work done. To systemise and possibly legitimise this kind of action-research, a longer-term financial security could be necessary - for a network facilitator and for research partners, including farmers. This could generate a leverage effect for a regional PPB project or new and fruitful collaboration between different research areas (eg. social and natural scientists), in order to lead transdisciplinary systems research - from seed to bread. However funding has proven difficult to obtain for such a transversal approach because most funding goes to highly specialised object-oriented research. This raises the question of how to legitimise this type of research.

4. Discussion

This case study of co-construction of a seed network is limited to a specific crop and region. However our results have a broader significance when put in perspective with other research found in literature. Firstly we link up with other similar studies on seed networks in Europe. Secondly we discuss challenges for participatory research and on-farm management of seed.

Experiences from other seed networks in Europe

The main outcome of our work is that it highlights that ever more farmers, but also other stakeholders, are reclaiming an active role in the cereal system and leading their own experiments. Informal local networks are emerging in Belgium with different starting points (e.g. find cereal seed adapted to organic farming practices vs. find market outlets for organic cereals) yet joining in a broader regional movement. Combette *et al.* (2015) claim that the generation gap in seed and associated knowledge transmission, very marked in western Europe, is one of the reasons why collaborating is almost a necessity for anyone willing to start working towards seed sovereignty. According to their experience with a French seed network, creating knowledge exchange opportunities can result in co-producing new knowledge and practices. Also collectively tackling a problem induces a faster progression and eventually more lasting than when facing it alone. According to Pimbert (2011), farmer networks and other types of platforms are “*key for mobilising capacity for social learning, negotiation and collective action for research into the management of agricultural biodiversity*”. Indeed food systems' modernisation generated disconnection and disembeddedness resulting in a loss of autonomy and identity (Milestad *et al.*, 2010). In these “*safe spaces*” the unvoiced can gain confidence to dialogue, frame alternatives, build alliances and act upon their food system. However, authors have pointed out that such spaces can also reproduce certain forms of exclusion (e.g. gender) or power issues if some precautions are not taken (Reason and Bradbury, 2006).

Challenges for participatory research and the on-farm management of seed

The young network on which our study focuses faces challenges, even more acute in the light of its rapid expansion. Can different perspectives and insights still be equally integrated when the number of involved members or geographical distance grows? This also demands a continuous self-reflexion on the way the network integrates the real-world and how it develops and communicates within it (Combette *et al.*, 2015). At this point challenges faced by the network bring forward two main questions. The first one is how to collectively define and agree upon rules for the use and circulation of seed. The second one is how to perpetuate the network and how to legitimise this type of action-research, in a context where funding is difficult to obtain. Lack of investment in variety breeding has been recognised as one of the factors hindering the development of organic farming in Europe (Chable *et al.*, 2012). But it is not the only barrier. Even when agricultural innovations do exist, they are not necessarily acknowledged and adopted. In Belgium, where our case study is located, low adoption of low-input disease-resistant varieties of wheat has been explained

as a consequence of the locked-in situation of the cereal system: the system is in a path-dependency due to factors existing at all levels of the food chain, from farmers to extension services and European policies (Vanloqueren and Baret, 2007).

Another question that arises from this co-constructed process is how can researchers support varietal novelty production and which change of approach does it involve? Identifying pathways on how to facilitate farmers' experiments and innovations involves reflexive thinking on the role of the researcher. Based on our findings and literature (Cuellar-Padilla and Calle-Collado, 2011; Louah *et al.*, 2015; Pimbert, 2011) we argue that in order to formulate farmer-relevant research questions and carry out research aimed at solving real problems lies in a radical reversal in the relative positioning of researchers towards farmers (and other actors of the food system). As Pimbert states *"this form of co-operative inquiry and participatory knowledge creation implies a significant reversal from the dominant roles, locations and ways of knowing"*. In other words: since they are the only "experts by experience", farmers take the lead and researchers accompany their quest for answers to their questions thanks to their access to tools and scientific knowledge. We no longer seek to integrate practitioners' knowledge to scientific thought through diverse forms of 'participatory research'. We rather seek to contribute to the development of safe-learning spaces that produce new knowledge for action. However adopting this collaborative research approach does not go unchallenged, in particular for young agronomists: gaps in academic education related to systems and collaborative research, time discrepancy between field and academic research, dealing with uncertainties and reflexivity etc. The researcher-facilitator needs to be comfortable with diversity, surprise and the unusual (Pimbert, 2011). Nevertheless, if we can overcome these difficulties and find new collaborative ways, co-constructed research offers great potential as novelties are directly produced (thus adopted) by actors involved. Results from participatory plant breeding programs in Europe and around the world are encouraging and provide valuable methodologies and tools (Cecarelli, 2012; Rivière *et al.*; 2013).

Our findings corroborate the 3 key challenges identified by Pimbert (2011) for participatory research and the on-farm management of seed in the European Union: (i) transforming knowledge into more holistic and transdisciplinary ways of knowing; (ii) scaling-up and institutionalising participatory plant breeding and agroecology; (iii) reversing policies and legal frameworks for equitable rights of access, use and control over seed. Regarding our case study of bread cereals, policies should foster community-oriented research and development to respond to the existing demand of both farmers and artisan bakery sector, which is directly linked to household demand. This involves a systemic approach of quality to increase the nutritional value of bread: health conscious choice of varieties, higher quality of flour type, improved baking processes.

5. Conclusions and perspectives

Our case study focused on the co-construction of the first Belgian cereal seed network as an example of one alternative pathway with regard to cereals for human nutrition (bread cereals in particular). This incipient seed network seeks to reintroduces diversity in cereal cropping (seed and practices) and answer bread quality concerns of artisan processors and households. To achieve these goals, seed and knowledge are exchanged within a safe-learning space gathering different actors of the cereal system: farmers, bakers, millers, gardeners, citizens and researchers. In order to improve the nutritional quality of bread and develop a more resilient cereal system, we suggest fostering collective management of seed and participatory plant breeding programs. This will need a reversal of agronomy research approaches and of priorities in food policy.

Acknowledgments

The authors thank all members of *Li Mestère* as well as L. Richelle, B. van Dyck and two anonymous reviewers for their very useful comments. Results presented in this paper are part of a PhD research supported by the Belgian Fonds National de la Recherche Scientifique and the University of Namur.

References

- Abraham, B., Araya, H., Berhe, T., Edwards, S., Gujja, B., Bahadur Khadka, R., Koma Y.S., Sen, D., Sharif, A., Styger, E., Uphoff, N., Verma, A. (2014). *The system of crop intensification: reports from the field on improving agricultural production, food security, and resilience to climate change for multiple crops. Agriculture & Food Security* 3:4.
- Bonnin, I., Bonneuil, C., Goffaux, R., Montalent, P., & Goldringer, I. (2014). *Explaining the decrease in the genetic diversity of wheat in France over the 20th century. Agriculture, Ecosystems & Environment*, 195, 183–192.
- Bueren, E.T.L., van Myers, J.R. (2012). *Organic Crop Breeding*. John Wiley & Sons.
- Chable, V., Louwaars, N., Hubbard, K., Baker, B., Bocci, R. (2012). *Plant Breeding, Variety Release, and Seed Commercialization: Laws and Policies Applied to the Organic Sector*. In *Organic Crop Breeding*. Chp 8, pp 139-159. Wiley-Blackwell.
- Ceccarelli, S., 2012. *Plant breeding with farmers. A technical manual*. ICARDA, Aleppo, Syria.
- Combette *et al.* (2015). *Gérer collectivement la biodiversité cultivée. Etude d'initiatives locales*. Dijon, Editions Educagri.
- Cuéllar-Padilla, M. & Calle-Collado, A. (2011). *Can we find solutions with people? Participatory action research with small organic producers in Andalusia. Journal of Rural Studies*, (27): 372-383.
- Darnhofer, I., Gibbon, D. and Dedieu B. (eds.) (2012). *Farming Systems Research into the 21st century: The new dynamic*. Dordrecht, Springer, 490 pp.
- Delcour, A., Van Stappen, F., Gheysens, S., Decruyenaer, V., Rabier, F., Burny, P., Stilmant, D. & Goffart, J.-P. (2012). *Cereals uses in Wallonia : context and issues. Agri-environment : perspectives on sustainable development. Gembloux. Les Presses Agronomiques de Gembloux ; Bioflux Publishing House : 87-94.*
- Delobel, V. (2014). “*Les Indomptables: An Ethnography of Niche Novelty Production in Walloon Agriculture*”. MSc thesis, Wageningen University, the Netherlands. Retrieved from Organic Eprints: <http://orgprints.org/25218/>
- Döring, T.S., Knapp, S., Kovacs, G., Murphy, K., Wolfe, M.S. (2011). *Review: Evolutionary Plant Breeding in Cereals—Into a New Era. Sustainability*, 3 (10), 2011: 1944-1971.
- Hajjar, R., Jarvis, D.I., Gemmill-Herren, B. (2008). *The utility of crop genetic diversity in maintaining ecosystem services. Agriculture, Ecosystems & Environment* 123: 261–270.
- Louah, L., Visser, M., Baltazar, S., Delobel, V. (2015). *Changements de postures du chercheur, de l'agriculteur et de l'enseignant pour l'innovation agroécologique paysanne. Pour* 2015/2 (N° 226) : 5-10.
- Martínez-Torres, ME., Rosset, P. (2014). *Diálogo de saberes in La Vía Campesina: food sovereignty and agroecology. The Journal of Peasant Studies*. DOI: 10.1080/03066150.2013.872632.
- Milestad, R; Bartel-Kratochvil, R; Leitner, H; Axmann, P. (2010). *Being close: The quality of social relationships in a local organic cereal and bread network in Lower Austria. Journal of Rural Studies*: 26(3): 228-240.

Osman, A., Chable, V. (2009). *Inventory of initiatives on seeds of landraces in Europe*. *Journal of Agriculture and Environment for International Development* 103, 95–130.

Pautasso, M., Aistara, G., Barnaud, A., Caillon, S., Clouvel, P., Coomes, et al., (2013). *Seed exchange networks for agrobiodiversity conservation: A review*. *Agron. Sustain. Devel.* 33:151-175.

Pimbert, M.P., and International Institute for Environment and Development. (2011). *Participatory Research and on-Farm Management of Agricultural Biodiversity in Europe*. London, IIED.

Reason, P., & Bradbury, H., eds (2006). *Handbook of Action Research: Participatory inquiry and practice*. Thousand Oaks, CA: Sage.

Remesy, C., Leenhardt, F., Fardet, A. (2015). *Donner un nouvel avenir au pain dans le cadre d'une alimentation durable et préventive*. *Cahiers de Nutrition et de Diététique*, 50 (1): 39-46.

Rivière, P., Pin, S., Galic, N., de Oliveira, Y., David, O., Dawson, J., Wanner, A., Heckmann, R., et al. (2013). *Mise en place d'une méthodologie de sélection participative sur le blé tendre en France*. *Innovations agronomiques* 32, : 427-441.

Stassart, P.M., Baret, Ph., Grégoire, J-Cl., Hance, Th., Mormont, M., Reheul, D., Stilmant, D., Vanloqueren, G., Visser, M. (2012). *L'agroécologie : trajectoire et potentiel. Pour une transition vers des systèmes alimentaires durables*. In Van Dam D. et al. (Eds), *Agroécologie entre pratiques et sciences sociales*, Dijon ; France : Editions Educagri.

Sutherland, L.-A., Burton, R. J. F., Ingram, J., Blackstock, K., Slee, B., & Gotts, N. (2012). *Triggering change: Towards a conceptualisation of major change processes in farm decision-making*. *Journal of Environmental Management*, 104, 142-151.

van der Ploeg, J.D. (2008). *The New Peasantries: Struggles for Autonomy and Sustainability in an Era of Empire and Globalization*. London, Earthscan.

Vanloqueren, G., & Baret, P. V. (2008). *Why are ecological, low-input, multi-resistant wheat cultivars slow to develop commercially? A Belgian agricultural 'lock-in' case study*. *Ecological Economics*, 66(2-3), 436-446.

Vara Sánchez, I., Cuellar Padilla, C. (2013). *Biodiversidad cultivada: una cuestión de coevolución y transdisciplinariedad*. *Ecosistemas*. 22(1):5-9.

Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., David, C. (2011). *Agroecology as a science, a movement and a practice*. *Sustainable Agriculture* (2) 27–43.