

Opportunities and Challenges of Participatory Approaches in Enhancing Agrobiodiversity

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Abstract: Agroecology represents a holistic approach in the transition to food system sustainability. It looks at the food system as a whole, in all its components and dynamic interrelations, and takes into consideration all the changes needed to move towards sustainability. This study aims at exploring the processes underlying the implementation of an agroecological approach, focusing on the learning processes that lead to the development of new, shared systems of knowledge, values and beliefs, and to the growth of reflexivity and agency. This study aims at deepening the understanding of these processes by analysing three initiatives that seek to contribute to the promotion of agrobiodiversity, a founding element of the agroecological model. All the initiatives presented in this study aim at rediscovering and valorising old and local varieties of bread wheat. A common feature is the interaction among multiple actors, who cooperate around this goal. The study focuses on the factors that enable the learning processes which underly the reintroduction of agrobiodiversity and looks at the effects of these processes in developing an integrated and transformative approach. Central to these processes is the integration of different types of knowledge and the reflexive learning stemming from the collective experience. To that regard, intermediation-facilitation is particularly significant, as it supports networking, interaction and further mobilisation of knowledge. The mechanisms ensuring effectiveness of mutual learning, particularly facilitation, are crucial. At the same time, they seem increasingly complex, showing the need for deeper research and adequate forms of support.

Key words: agrobiodiversity, mutual learning, reflexive learning, innovation brokerage, distributed facilitation.

1. Introduction

It is widely acknowledged how transition to food system sustainability requires multiple changes, through a coevolution of technological, social and institutional components. Transition entails taking into account the interconnections of these different domains, looking at the whole set of needed changes as a system innovation. Within this plurality of forms of transition that have developed during the last decades (Hinrichs, 2014), the model of agroecology has been representing, over the course of its evolution, a promising integral option (Wezel et al., 2009; Gliessman, 2013). It looks at the food system as a whole, in all its components and its dynamic interrelations, as well as takes into consideration all the needed changes to move towards sustainability. The concept of “ecology of the food system” (Francis et al., 2003) and the growing attention to the influence of social, cultural and institutional-political factors on the adoption of sustainable practices, well express the systemic vision that has been increasingly characterising agroecology (Méndez et al., 2013). In addition, over its evolution this model has been attaching a particular importance to the integration of three key components (Wezel et al., 2009; Gliessman, 2013; Wakeford et al., 2016): an epistemological approach oriented to knowledge co-creation (the dimension of agroecology as a science), the development and dissemination of coherent operational models (agroecology as practice), and a transformative perspective, as a process of social innovation aimed at significant system change (agroecology as a movement). The coexistence of these three components and how they manifest – respectively, the participative-democratic approach to research, the holistic and reflexive redefinition of practices, the dimension of social and political engagement,

empowering marginalised actors and aimed at promoting collective action towards significant system changes – are expression of the comprehensive and normative approach to transition towards sustainability that characterises agroecology.

This study aims at exploring the processes underlying the implementation of an agroecological approach, focusing on the interactive and iterative learning processes that are at the basis of the development of new systems of knowledge, alignment around shared values and beliefs, growth of reflexivity and agency. These outcomes are considered important since they are instrumental to address the multiple dimensions involved in the needed changes, coherently with a systemic approach. Looking at these processes, particular attention is paid to the encounter-integration of different sources of knowledge and the potential development of reflexive learning from the collective experience. Significant to that end is the presence of an enabling social environment where these processes may take place and the means by which to favour it.

These processes are analysed through three case studies concerning local initiatives centred around the reintroduction of agrobiodiversity in production processes and its valorisation through the market. Farming and food practices aimed at enhancing agrobiodiversity are indeed an integral part of the agroecological model, of which they express the systemic approach, mechanisms of knowledge creation and transformative purposes. Reintroducing agrobiodiversity requires facing technical-technological, organisational, social, cultural, economic, institutional and legal challenges. Indeed, it entails: overcoming the lack of these diverse genetic resources in the seed market, facing the regulatory constraints and creating conditions for reproduction and commercialisation; redefining cultivation practices and processing technologies; looking for economic sustainability along the various supply chain stages; recreating horizontal connections among farmers as well as reorganising relationships along the supply chain; empowering of traditionally marginalised actors; developing acknowledgement and appreciation of the multiple (environmental, ethical, social) values of genetic resources/production systems/final products. All this requires significant processes of new knowledge generation, values sharing, reflexivity raising. Alongside the redefinition of practices and organisational models, the development of collective awareness and agency may foster further mobilisation around agrobiodiversity enhancement, positioning this issue in more significant frameworks of meaning (e.g. farmers' rights, food justice, food sovereignty) and in the policy arena (e.g. genetic resources regulatory framework) (Kloppenburg, 2010; Bocci, 2014; Humphries et al., 2016), again coherently with a systemic vision.

The article develops a framework to analyse the described initiatives by referring especially to the literature on the characters and potential of learning processes in social innovation aimed at sustainability goals (Knickel et al., 2009; Elzen et al. 2012; Moschitz et al., 2015) and on the role of intermediation in system innovation processes (Howells, 2006; Kilelu et al., 2011; Klerkx et al., 2012a,b; Tisenkopfs et al., 2015a). By means of a comparative analysis, the article sheds light on the learning processes underlying the reintroduction of agrobiodiversity and their effects in terms of development of an integrative approach to the matter and of a transformative purpose. Intermediation, in its different forms, is assumed to play a key role for these processes to happen and represent a central subject of the analysis. In this way, the study aims at contributing to the reflection on the creation of an enabling environment to processes of transformation of farming-food practices towards sustainability. On that basis, it provides insights to research and policy.

In the following sections of the article, we define the conceptual framework adopted in the study, explain our methodological approach, briefly describe the studied initiatives, analyse them through the defined frame and present our final remarks.

2. Theoretical Framework

The agroecology perspective well exemplifies the systemic vision and transformative approach that are necessary to address the complex challenge of transition to sustainable agro-food systems. Looking at the food system as a whole requires taking into consideration all the different factors that affect the adoption of sustainable practices, from the very technical-technological aspects, to social, cultural, economic implications, to legal and institutional components; this from the early stages of the production process to the practices around final products (Francis et al., 2003). It also demands to assume a multi-scale perspective, by connecting the change experimented at the local scale, in specific contexts, to the needed changes at the global scale. Facing this complexity requires the development and sharing among multiple actors of new suitable knowledge, as well as the alignment around common values and beliefs.

In line with the most recent theoretical approaches to transition to sustainable agro-food systems (Knickel et al., 2009; Brunori et al., 2013; Moschitz et al., 2015; Tisenkopfs et al., 2015a), the participatory approach of agroecology and its attention to context-based processes see a favourable environment for these co-creation of knowledge and alignment in the interaction that develops within multi-actor networks (Milgroom et al., 2016). Within this collaborative context, furthermore, the encounter of various perspectives and claims coming from the production world, the scientific community and the civil society can give rise to that new reflexivity (Voß and Kemp, 2006; Popa et al., 2015) that is needed to pursue a transformative action (Méndez et al., 2013). The political dimension of agroecology indeed goes even “beyond the idea of co-production of knowledge to take up the mobilisation of existing and newly co-produced knowledge as a part of political struggles to transform the food system.” (Wakeford et al., 2016, p.42).

As highlighted for other pathways towards agro-food sustainability (Curry and Kirwan, 2014; Šūmane et al., 2017), different forms and contents of knowledge as well as different value systems and visions are mobilised in these interactions: traditional understanding and practices about farming and processing, generally in the form of informal, experiential, integrative and context-base knowledge; inputs coming from different areas of the scientific research, formal and specialised; knowledge on institutional and political issues developed by civic movements, together with claims expression of specific normative orientations (Elzen et al., 2011; Méndez et al., 2013; Milgroom et al., 2016). The creation of conditions for this intercultural dialogue, within an inclusive, democratic and collaborative environment, is crucial. This means adopting interdisciplinary approaches in the relations between different areas of research and transdisciplinarity in the interaction between practitioners and scientists, as well as creating conditions for wide and effective participation in all the phases of knowledge creation (Méndez et al., 2013). Along with these processes, the role of the various actors involved around food practices can change, introducing new potentialities (Elzen, 2012). The first example is again that of the empowerment of farmers, from their inclusion in shaping research questions and designing projects to their becoming autonomous in running the research. Together with the creation of a common pool of new knowledge, also sharing new systems of values represents another crucial condition. The adoption of a transformative perspective entails integrating a normative approach as a leading principle in the knowledge co-production and management, the re-shaping of practices and further engagement in collective actions.

Social learning that develops through the multi-actor interaction is central in these processes. It allows aligning the views of different stakeholders, developing and actualising system thinking and adopting a common transformative attitude. In doing so, it acts in different ways and at different scales. As more, in general, occurs in innovation aimed at facing relevant

challenges, this learning includes different levels: first order learning, which is linked to experience and supports the implementation of practices and related coordination; second order, reflexive learning, which questions assumptions and fosters the development of new patterns of thinking and action, thus leading to more significant changes as well as to a reflexive and dynamic approach towards the changes being made (Kemp et al, 1998; Elzen et al. 2012; Moschitz et al., 2015). Crucial to this double-loop, transformative learning are those reframing processes – collective development and sharing of new cognitive and normative frames – that lead to a radical shift in understanding and in value systems (Goffman, 1974; Tisenkopfs et al., 2015b). From this learning common awareness, visions and attitudes, and consequently coherence in action and coordination can develop.

As said above, this learning is significant in a multi-scale perspective too. In its horizontal dimension, developing within the social spaces of interactions of multi-actor networks, it enables the creation and spreading of new practices and institutions around food matters. In this same context, it also promotes understanding of, interest in and agency for more significant system changes, for example through actions at higher levels of governance or on cultural patterns. The mobilisation that can stem from these processes may in turn promote other learning processes, including other actors, potentially leading to conducive conditions for change. The literature exploring processes of innovation towards sustainability considers this last process an important factor in the dynamics of vertical interaction between innovation niches and regime (Elzen et al., 2012; Ingram et al, 2015).

The ways learning processes occur in reality may be further different, as they may lie on cognitive learning but also see the importance of experiential learning. This is a known mechanism for farmers (Woods et al., 2014; Darnhofer et al., 2016) but it also involves other actors who question mainstream practices of food production or consumption. As important is the role of other informal mechanisms that may accompany and affect learning, as those of social, cultural and psychological nature and, more in general, factors stemming from the embeddedness in the specific contexts. As in other manifestations of social innovation around food practices, the great effectiveness of community-based social learning emerges, where change of actors' mind-set benefits from the sense of belonging to a common pathway (Røpke, 1999; Seyfang and Haxeltine, 2012; Šūmane et al., 2017). All this confirms how relevant the social dimension of learning is, from the inner mechanisms of reframing to the creation of a supportive environment.

From all the above, the importance of some factors emerges, such as: presence of enabling relational spaces; empowering processes aimed at ensuring a factual participation of all stakeholders, especially of those traditionally disadvantaged in the conventional system of knowledge creation-transmission; mechanisms that facilitate the encounter and interaction among different “worlds”, supporting “vertical and horizontal cross-connections” (Hinrichs, 2014, p.150). In short, the management of the multiple resources, interactions, dimensions and scales involved. Functions of intermediation are considered as crucial in this regard (Howells, 2006; Moschitz et al., 2015; Klerkx et al., 2012b). As known, an extensive body of literature has been produced on this, along with the evolution of the approach to supporting agriculture innovation (AKIS, AIS). The increasingly urgent need for a transition to sustainability has made these functions even more significant and has stressed the greater suitability of an innovation systems perspective (Klerkx et al., 2012b). Within them, we think that learning processes are still central. At the same time, the complexity of the processes involved leads us to consider a more advanced approach to intermediation (or, as we say, facilitation) as crucial, looking at a more articulated, interconnected and distributed function (Klerkx et al., 2012a,b; Tisenkopfs et al., 2015a; Moschitz et al., 2015), to be supported through adequate approaches.

3. Analytical Framework and Methods

We thus take into consideration the manifestation of all the above mentioned processes in actions around agrobiodiversity enhancement, more or less embedded within the holistic and transformative approach of the agroecology model. We focus in particular on the interaction and social learning dynamics that underlie the processes of reorganisation around agrobiodiversity reintroduction, and the implications they have, ranging from the development of awareness on the meaning of agrobiodiversity to the growth of collective reflexivity and transformative attitude.

We analyse these dynamics with reference to the following main stages (Fig.1):

- mobilisation of genetic resources: their material reintroduction, the understanding and acknowledgment of their environmental and social values
- re-organisation of production processes: new practices, technology, forms of product qualification, forms of coordination, organisational models
- valorisation of these genetic resources through the market: commercialisation, communication
- adhesion to collective actions of enhancement of agrobiodiversity
- awareness raising on social-legal-political issues and mobilisation.

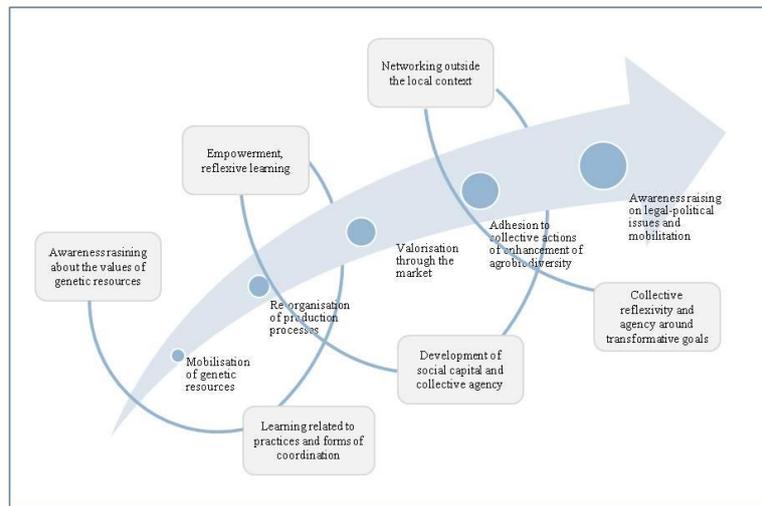


Fig.1 - Learning processes and collective engagement around agrobiodiversity enhancement

With reference to such sequence and interconnection of actions and learning, we analyse the development of the three initiatives looking at the main factors underlying multi-actor processes of co-creation of new awareness, knowledge and skills, attitudes, motivations and reflexivity (Fig.2):

- actors involved and their way of interacting
- forms of knowledge mobilised (pre-existing, shared, co-created)
- facilitation actions put in practice

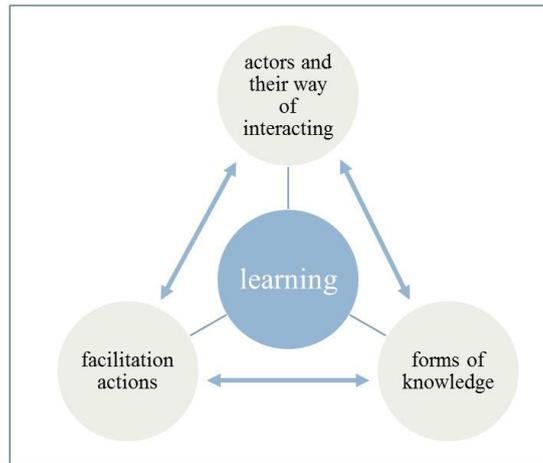


Fig.2 - Actors, interactions, knowledge and facilitation actions engaged in learning processes

The study draws on three case studies developed during 2016 and 2017 within the EU funded project DIVERSIFOOD (Horizon 2020; www.diversifood.eu). In particular, work package 5 dealt with exploring the mechanisms underlying the enhancement of agrobiodiversity along the whole supply chain. The case studies describe initiatives taking place in Italy, and aimed at rediscovering and valorising traditional varieties and local landraces of wheat for the production of bread. These genetic materials are more suitable to organic farming and present good nutritional-nutraceutical properties.

According to a constructivist and subjectivist methodological approach, the case studies are based on qualitative data and the research design and result validation were carried out in a participatory manner.

4. The Case Studies

In the following sections we briefly illustrate each of the three initiatives making reference to the factors that we have identified.

1. *Floriddia Farm and its Network*

Floriddia is an organic farm that since 2009 has been cultivating only traditional varieties, landraces and evolutionary populations of wheat, motivated by the desire to make its farming even more coherent and to produce healthy food. The farm processes and sells locally, directly to consumers or to small retailers. The breeding process is partially internalised; the farm reproduces the seeds for farming. Over the last years, the farm has established close relationships with other local farmers, for production and breeding activities. More in general, the farm interacts actively with other farmers, millers, bakers, retailers, organized groups of consumers. Particularly important are the relationships with the Tuscan Network of Organic Farmers and with Rural Seed Network (RSR) - a civil society organization engaged in the promotion of agrobiodiversity at farming level and through advocacy at political level -. It also interacts with various researchers (most importantly with a geneticist from the University of Florence), other local networks, public actors. Over the years, RSR has greatly contributed to broaden Floriddia's vision of the farming activities, now conceived as an agro-ecosystem, going beyond the organic farming model itself. Furthermore, by connecting the farm

experience with that of other members of its own network, it integrated it into a broader collective action around agrobiodiversity.

2. *Heritage Wheats of Montespertoli Association*

“Heritage Wheats of Montespertoli” Association (HWMA), founded in 2010 (formally established in 2014), runs a supply chain that goes from the breeding of landrace wheat varieties to the commercialisation of the final products. It includes producers, processors and intermediate users, who can use the related trademark by adhering to the production specifications. The breeding process is internalised; both the production and reproduction activities are annually planned collectively through the help of an agronomist. The initiative was promoted by a miller and a baker to revitalise local bread production. The interest in heritage varieties came later, after meeting a geneticist from the University of Florence who helped them to introduce this genetic material. The agronomist is the bridge between scientific knowledge and the traditional knowledge of practitioners. Through this collaboration, they started rediscovering traditional ways and means for milling and baking. The initiative involved other farmers and the Municipality, which contributed to its spreading. The agronomist and the professor worked also to bridge HWMA with other initiatives working on traditional varieties. The connection with RSR was particularly meaningful. The territorial focus still prevails, but now the Association is aware of being part of a bigger community.

3. *The Virgo Project*

The Virgo project started in the early 2000s around bread based on five traditional wheat varieties. It was born from a formal collaboration between a group of biodynamic farmers and a researcher from the University of Bologna, who were moved by the idea that farming and processing heritage wheats could be an opportunity to safeguard consumers’ health and to ensure fair incomes to small farmers. From 2009 to 2015 the project was funded by the Regional Government. This allowed doing field, baking and lab experiments. One farmer has made investments to internalise all steps of the production, including cleaning of seeds, milling and bread making, on farm; he also provides services to the other farmers, who remain however independent in their activities, also one from the other. This farmer was the initial connection point between the University and other interested farmers and still remains the main contact. He also contributed to the establishment of a relation with RSR, which grants him support in organizing local awareness raising events. The researcher from the University of Bologna collaborates with RSR in European-funded research projects. Nowadays the project is at a turning point. The researcher would like to expand it, while the farmers want to maintain a community dimension.

5. Analysis

The three case studies provide interesting insights on the role of learning processes that develop within multi-actor networks aimed at sustainability goals, as well as on the related enabling factors.

5.1. *The Role of Learning in Positioning and Handling Agrobiodiversity*

The initiatives confirm the relevance of learning processes, indeed involving all the stages, from the introduction of diverse genetic resources, to their valorisation through the market, to the development of collective agency around agrobiodiversity issues (Fig.1). Social learning leads to the creation of new shared knowledge, but it is also essential for the alignment of the various involved actors around same visions and beliefs, and, as we said, to develop further reflexivity. These initiatives also highlight the dynamics that develop from the encounter of different types of knowledge, mediated by the attitudes of each actor and by the evolution of

these along with mutual learning. As important is the action of facilitation of this interaction carried about by some of the actors.

These processes prove to be significant for the approach to the genetic material, as well as for the adaptation of farming practices and processing technology. The understanding and acknowledgement of the multiple values of varieties and landraces, as well as the development of skills to handle them properly constitute a first, important challenge to face. To that end, the inputs coming from scientists and organisations engaged in agrobiodiversity issues prove to be crucial to trigger learning; the latter, in particular, contribute to foster reflexive learning by broadening the meaning of working on diverse genetic resources. The interaction among practitioners in turn contribute to amplify these learning processes horizontally. The development of autonomous capacity in managing and experimenting with this genetic material represents a further step in this process: the integration between the new inputs and the farmers' accumulated knowledge may combine with a strong motivational basis, giving rise to a meaningful process of empowerment. This in turn may foster further willingness to learn and agency. The Floriddia and Virgo cases are emblematic in this sense. In the former, because of use of evolutionary populations, this aspect is particularly significant since the crop is dynamically evolving, thus resulting more demanding in terms of farmers' experience and skills. More in general, the boost by RSR and the geneticist to take a wider view of the role of agrobiodiversity in farm practices and to move forward in innovating with plant breeding finds a fertile ground in the mutual learning that develop through interaction among the parts. In Virgo case, the farmers' growth in awareness and experience around traditional varieties, combined with a strong identity as a farming community (biodynamic agriculture), has led to the definition of an own strategy, independent from that one defined by the University, which was perceived as no more aligned with their vision.

The generation of new knowledge and shared beliefs is significant also in the changes in processing practices. Also in this case, the need to reshape the technology sees an integration between, on the one hand, scientific and technical knowledge and, on the other, practitioners' accumulated knowledge and new experiential learning stemming from the process of knowledge integration itself. This means that there is no passive acceptance of external expert knowledge. The further fine-tuning of the practices results from the integration of experiential knowledge of the actors that are directly involved, namely millers and bakers, who thus take full control of the "new" process.

Sharing new knowledge and alignment around common beliefs and motivations prove to be important to assure a good functioning of the collective projects; it also supports the development of a common view of the actions undertaken and collective agency around shared goals. This is at the basis of the definition of common rules and norms, which may translate into forms of coordination along the supply chain or within the network (e.g. for seed and products management, use of quality signs for final products, economic value distribution). All initiatives showed the importance of these processes in the functioning of the supply chains or, even more, in implementing alternative organisational models such as the formal agreement between Floriddia and the local farmers, the code of practice for the use of the collective trademark for the Montespertoli bread and the rules governing the Virgo initiative. Even in presence of shared knowledge, the lack of alignment around values and beliefs may generate divergences or conflicts (as shown in the Virgo project, where farmers and researchers have different views about future developments).

Shared learning is also the basis of the valorisation strategy through the market, where the communication practices have to convey the values embodied in the food products in an effective way (this aspect being crucial to create conditions for the reproduction of the whole

production system together with the genetic resources managed). Here, the new knowledge and attitudes developed among the actors involved in production come into play in the relationships established with intermediate users and final consumers, triggering new mutual learning.

Learning processes can develop within relational structures that extend beyond the farm and the supply chain boundaries, as well as beyond the local context itself. Both the dimensions are important. The first allows implementing an innovative approach to agrobiodiversity management, not only based on active involvement of farmers but also grounded in participation and engagement of local communities (as in the cases of Floriddia and Montespertoli). In the same context, the enhancement of agrobiodiversity itself is seen as part of a broader reorganisation of farming-food practices. The second dimension of interaction proves to be supportive to catching new opportunities and, more in general, to widening the horizons further. Sharing reflexive thinking within other networks favours the growth of awareness and collective agency, which helps to see the undertaken initiatives as part of broader projects and may lead local networks to engage in further effort for change. To that end, the same capacity and willingness to networking allow accessing important resources to support change (public funds, relations, joint projects). These processes are evident in the Floriddia case, where the farmers interact intensively at local level and are a node of a wider network at national level, in turn interacting at international level. Within these networks useful collaborations have developed, as those around research (in regional, national and European projects).

5.2. The Factors Affecting Learning Processes

Crucial to these processes of development of new, shared awareness and motivations, knowledge and skills, reflexivity, autonomy and agency around agrobiodiversity issues are, as we said, the ways in which the different actors, carriers of different knowledge and visions, interact. The empirical evidences show in this regard how establishing equal and trust-based relationships may be fruitful. This concerns all the involved actors (the closeness characterising Floriddia and Montespertoli networks is emblematic); it is however particularly evident in the relationships between scientists and practitioners. Indeed, the researchers' attitude in making available their expertise, within an equal relationships, strongly affects the development of mutual learning. Indeed, the cases analysed show that even the scientific knowledge creation may be inclusive or strongly participatory, allowing overcoming asymmetrical power relations, and, thus, creating conditions for further learning. This emerged for plant breeding, but also for knowledge about processing technology or nutraceutical properties of products. According to an action research perspective, researchers' capacity to adopt a holistic approach to the systems they interact with, avoiding specialization and rather embracing all the needed dimensions of change process, is crucial. The sensitivity towards social and cultural aspects, as well as economic implications is an added value in promoting technical innovations. Not less importantly, the adoption of a clear normative stand on the issues faced is a substantial component of the trustful relationship established with the other actors. Indeed, it is associated with a strong commitment to the cause.

In addition to the contribution from individual attitudes, mutual learning processes greatly benefit from the presence of facilitation actions, bridging different types of knowledge and experience, and favouring interaction and cooperation. The initiatives analysed have shown that this function can be played by advisors or by other entities, such as civil society organisations engaged in the agrobiodiversity/sustainability issues. These initiatives indeed do not involve any traditional AKIS agent. The kind of support that is needed to foster these processes of awareness and knowledge raising is meaningful. It includes technical and organisational assistance, but also cultural and social animation, up to include more complex

empowering and mobilisation actions. RSR's role is emblematic in this regard: it has been acting as intermediary between the various actors/networks and facilitating the engagement in and integration among different areas and scales of action (Howells, 2006; Klerkx et al., 2012b). As more in general in the agroecological model, the capacity to adopt a system vision is central in dealing with agrobiodiversity issues. In this perspective, RSR's action is aimed at creating interconnections at horizontal and vertical level. Horizontal connections link different actors, networks and territories, to foster the development and spreading of alternative approaches in production-consumption practices centred on agrobiodiversity; vertical connections reach out to higher levels of thinking and governance, thus positioning locally-based initiatives into broader frameworks of action. The importance of this facilitation action emerges clearly in the Floriddia case, where the degree of alignment and reflexivity among all the actors has been increasing. On the contrary, in the Virgo case, its absence may explain the more difficult relationships between farmers and researchers, as well as, among farmers, the lack of a shared strategy and of further evolutionary processes. In the Montespertoli case, facilitation has been mainly managed by an advisor and is rather focused on creating enabling conditions for the organisation of the local, community-based production system, where the choices related to genetic material are instrumental to improve the product quality and to support the marketing strategies. Implementing more sustainable agro-food systems, broader networking and further transformative goals seem here to be less important.

Both these factors – the actors' attitude and the intermediation-facilitation actions – thus seem to contribute to create an environment conducive to mutual learning, enabling complementarity of different kinds of knowledge and giving rise to a common pool of knowledge, accessible to everyone, as well as favouring alignment around common beliefs and strengthening motivations.

6. Towards a More Advanced Vision of Knowledge Co-Creation and Facilitation

All these aspects seem useful to understand role and mechanisms of learning processes in the definition and diffusion of more sustainable food production-consumption practices. The importance of these processes and of their functioning is widely acknowledged, both in the research (Tisenkopfs et al. 2015a; Moschitz et al., 2015) and in the political agenda. European policies for innovation have invested and will continue to invest on them. However, our understanding of the complexity of these dynamics can be further improved.

Our study first confirms the recommendation that measures and actions to create supportive conditions should primarily facilitate networking and through it, interactive and iterative processes of thinking and action. The analysis also confirms the importance of facilitation actions to that end (we prefer this term to that of intermediation because it is even more effective in representing the complex function performed). As we saw, the presence of these actions can make the difference, enabling and enhancing co-learning among the various actors, supporting alignment processes, favouring integrative approaches and fostering innovation. However, mechanisms ensuring the effectiveness of learning networks and the facilitation function itself seem more complex, showing the need for deeper research and adequate forms of support.

Our analysis highlights how knowledge creation may evolve along with the learning processes, thanks to progressive accumulation of knowledge and different orders of learning; it also shows that the management of this process is more fluid than commonly believed. As we stressed, the evolutionary character of knowledge creation is significant in pathways aimed at a transformative action, such as, potentially, agrobiodiversity enhancement and, for definition, agroecology. As far as the management of the process is concerned, it emerges that within learning networks characterised by close internal interaction and engagement in mutual

learning the individual actors, over time, actively handle the common pool of knowledge, so contributing to multiply the poles of creation, spreading and application of knowledge.

In addition to an already described complementarity between formal and informal knowledge (Šūmane et al., 2017), another significant result is the re-allocation of formal knowledge generation, no more prerogative of scientific institutes, and of informal knowledge generation, involving all the actors, from farmers to scientists. We have shown how civil society organisations may be engaged in scientific experiments and in spreading the related results, how farmers involved in participatory plant breeding may acquire mastery of the matter and become autonomous in experimenting, how action-researchers may learn together with practitioners. Of course, the implementation of an integrative, inclusive and democratic approach to knowledge creation is not a novelty (Pimbert, 2006). What seems more advanced here is that actors' role may evolve, making the division of roles less sharp and giving rise to new potentialities (Elzen, 2012). In addition to a closer integration in knowledge creation, our observations confirm the innovation potential of agroecology multidimensionality of actions – new knowledge creation, re-definition of practices and mobilisation around transformative goals (Méndez et al., 2013). Through shared learning processes, these areas of engagement may normatively involve all the actors, contributing to the implementation of a systemic and transformative approach.

This highlights another aspect to take into consideration when thinking of processes of innovation, namely the importance of sharing visions, values and beliefs, and the consequent effect in terms of trust, willingness to cooperate, sense of mutuality and shared commitment. As we have repeatedly said, this alignment may also stem from shared learning and is a fundamental component of the development of collective agency. Its lack may weaken these processes. As important is its management and valorisation over time. Facilitation actions, working also on social and cultural dynamics, play a key role in taking care of these aspects.

We see in what we have analysed interesting insights to further refine and enhance the function of facilitation in enabling adoption of more sustainable practices. The complexity of change in farming-food practices has shown the importance of proper actions of facilitation, able to intervene in multiple areas – not just technical, but also institutional, legal, social and cultural domains –, taking also into consideration the interconnections among these areas. In addition to that, understanding the relational dynamics within the networks results equally important. This view of facilitation is in line with the acknowledgement of the broader concepts of innovation brokerage or systemic facilitation (Kilelu et al., 2011; Klerkx et al., 2012a,b). Our analysis has shown that this kind of facilitation may be played by new actors, directly involved in the initiatives, as in the case of RSR. Despite the value of what done, this represents a weakness in the system, since this role is not formally recognised and supported. There is however another point to consider: based on our evidence, the system of creation of new knowledge has become much more complex, including a variety of mutually interacting actors. In this context, identifying a single figure facilitating knowledge creation is challenging, as this function is executed by multiple actors, together with the increasing integration of their respective role around common goals. This confirms the importance of adopting a different perspective, foregrounding a distributed, sometimes collectively managed facilitation rather than a role played by a specific category (Kilelu et al., 2011; Klerkx et al., 2012a,b). All this requires adopting a more advanced approach to these processes, and consequently thinking of innovative policy measures to support them.

7. References

- Bocci, R. 2014. "Seeds between freedom and rights" *Scienze Territorio*, 2, 115–121.
- Brunori G., D. Barjolle, A.C. Dockes, S. Helmle, J. Ingram, L. Klerkx, H. Moschitz, G. Nemes and T. Tisenkopfs. 2013. "CAP Reform and Innovation: The Role of Learning and Innovation Networks." *EuroChoices*, 12 (2).
- Curry, N., Kirwan, J., 2014. "The role of tacit knowledge in developing networks for sustainable agriculture", *Sociologia Ruralis*, vol. 54(3), 341-361.
- Darnhofer, I., Lamine, C., Strauss, A. and Navarette, M., 2016. "The resilience of family farms: towards a relational approach." *Journal of Rural Studies*, 44, 111-122.
- Elzen B., Geels F.W., Leeuwis C. van Mierlo B., et al. 2011. "Normative contestation in transitions 'in the making': Animal welfare concerns and system innovation in pig husbandry", *Research Policy* 40, 263–275.
- Elzen, B., M. Barbier, M. Cerf and J. Grin 2012. "Stimulating transitions towards sustainable farming systems". In: I. Darnhofer, D. Gibbon and B. Dedieu (eds). *Farming Systems Research into the 21st Century: The New Dynamic*. Springer, Netherlands, pp. 431-455.
- Francis, C., Rickerl, D., Lieblein, G., Salvador, R., Gliessman, S., Wiedenhoef, M., Breland, T. A., Simmons, S., Creamer, N., Allen, P., Harwood, R., Altieri, M., Salomonsson, L., Flora, C., Helenius, J., Poincelot, R., 2003 "Agroecology: the ecology of food system", *Journal of sustainable agriculture*, vol. 22.
- Gliessman, S. 2013. "Agroecology: Growing the Roots of Resistance", *Agroecology and Sustainable Food Systems*, 37(1):19–31.
- Goffman E. 1974. *Frame Analysis: An Essay on the Organization of Experience*. Cambridge, MA, US: Harvard University Press.
- Hinrichs, C.C. 2014. "Transitions to sustainability: A change in thinking about food systems change?" *Agric. Hum. Values*, 31, 143–155.
- Howells, J. 2006. "Intermediation and The Role of Intermediaries in Innovation". *Research Policy* 35 (5): 715-728.
- Humphries S., Rosas J.C. and Gomez M. 2016. "A farmer-NGO-scientist synergy", *Farming Matters Magazine*, 14-16.
- Ingram, J., Maye, D., Kirwan, J., Curry, N., Kubinakova, K., 2015. "Interactions between niche and regime: an analysis of learning and innovation networks for sustainable agriculture across Europe". *J. Agric. Educ. Ext.* 21 (1), 55e71.
- Kemp, R.; Schot, J.; Hoogma, R. 1998. "Regime shifts to sustainability through processes of niche formation: The approach of Strategic Niche Management." *Technol. Anal. Strateg. Manag.*, 10, 175–1958
- Kilelu, C.W.; Klerkx, L.; Leeuwis, C., Hall, A. 2011. "Beyond Knowledge Brokering: An Exploratory Study on Innovation Intermediaries in an Evolving Smallholder Agricultural System in Kenya", *Knowledge Management for Development Journal* 7.1: 84–108.
- Klerkx, L., van Mierlo, B., and Leeuwis C. 2012a. "Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions.", In Darnhofer, I., Gibbon, D., Dedieu, B. (Eds.) *Farming Systems Research into the 21st Century: The New Dynamic*, Springer, 457-483.
- Klerkx L., Schut M., Leeuwis C. and Kilelu C. 2012b. "Advances in Knowledge Brokering in the Agricultural Sector: Towards Innovation System Facilitation", *IDS Bulletin*, 43 (5).

- Kloppenburg, J. 1991. "Social theory and the reconstruction of agricultural science: local knowledge for an alternative agriculture". *Rural Sociology* 56: 519–548.
- Kloppenburg, J. 2010. "Impeding Dispossession, Enabling Repossession: Biological Open Source and the Recovery of Seed Sovereignty", *Journal of Agrarian Change*, 10(3), pp. 367–388.
- Knickel, K., Brunori, G., Rand, S., and Proost, J. (2009). "Towards a Better Conceptual Framework for Innovation Processes in Agriculture and Rural Development: From Linear Models to Systemic Approaches". *J. Agr. Educ. Extens.* 15(2): 131-146.
- Mendez, V. E., Bacon, C. M., and Cohen, R., (2013) "Agroecology as a Transdisciplinary, Participatory, and Action-Oriented Approach", *Agroecology and Sustainable Food Systems*, 37:3–18.
- Milgroom, J., Bruil, J., Leeuwis, C., 2016, "Co-creation in the practice, science and movement of agroecology", editorial *Farming Matters Magazine*, 5-8.
- Moschitz, H., Roep, D., Brunori, G., Tisenkopfs, T., 2015, "Learning and Innovation Networks for Sustainable Agriculture: Processes of Co-evolution, Joint Reflection and Facilitation", *Journal of Agricultural Education and Extension*, 21(1), 1-11.
- Pimbert M. (2006). *Transforming Knowledge and Ways of Knowing for Food Sovereignty*, International Institute for Environment and Development (IIED), London.
- Røpke, I. 1999. "The Dynamics of Willingness to Consume", *Ecological Economics*, 28(3).
- Seyfang G., Haxeltine A. 2012. "Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions", *Environment and Planning C: Government and Policy*, volume 30, 381–400.
- Šūmane S., Kunda I., Knickel K., Strauss A., Tisenkopfs T., des Ios Rios I., Rivera M., Chebach T., Ashkenazy A. 2017. "Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture", *Journal of Rural Studies* xxx (2017) 1-10.
- Tisenkopfs T., Kunda I., Šūmane S., Brunori G., Klerkx L., Moschitz H., 2015a. "Learning and Innovation in Agriculture and Rural Development: The Use of the Concepts of Boundary Work and Boundary Objects." *The Journal of Agricultural Education and Extension* 21, 13-33.
- Tisenkopfs T., Kunda I. and Šūmane S. 2015b. "Learning as Issue Framing in Agricultural Innovation Networks", *The Journal of Agricultural Education and Extension*, 20:3, 309-326.
- Voß J.P. and R. Kemp 2006. "Sustainability and reflexive governance: introduction", In Voß J.P., Bauknecht D. and R. Kemp (eds): *Reflexive Governance for Sustainable Development*, Edward Elgar Publishing.
- Wakeford T., Anderson C., Charanya R. and Pimbert M. 2016. "Strengthening people's knowledge", *Farming Matters Magazine*, 40-43.
- Wezel, A., Bellon, S., Dorè, T., Francis, C., Vallod, D., David, C., 2009, "Agroecology as a science, a movement and a practice. A review", *Agronomy for sustainable development*, 29(4): 503–515.
- Wood, B.A.H.T., Blair, D.I., Kemp, P.D., Kenyon, P.R., Morris, S.T., Sewell, A.M., 2014. "Agricultural science in the wild: a social network analysis of farmer knowledge exchange". *PLoS One* 9 (8).