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# From Co-Learning to Shared Commitment to Agroecology. Some Insights from Initiatives Aimed at Reintroducing Agrobiodiversity

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**Abstract:** Agroecology represents a holistic approach in the transition to food system sustainability, integrating different dimensions, including knowledge creation, practices redefinition and social mobilisation. This study aims to explore the processes underlying the implementation of the agroecological approach and its transformative potential, 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. It aims at deepening the understanding of these processes by analysing the reintroduction of agrobiodiversity in crop/food systems, considering this as a founding element of the agroecological model. Three initiatives located in Italy are investigated to that end. The study analyses role, mechanisms and potential of co-learning processes that develop within the multi-actor networks involved, uncovering enabling and hindering factors. It focuses on the role, reciprocal articulation and cumulative effects of three elements: actors involved and ways of interacting, types of knowledge mobilised and facilitation actions carried out. The findings highlight that the factors ensuring effectiveness of mutual learning, such as modes of actor interaction and, particularly, facilitation, are crucial. At the same time, the mechanisms that intervene seem increasingly complex, showing the need for deeper research and adequate forms of support.

**Keywords:** agrobiodiversity; agroecological transition; social learning; transformative learning; intermediation; distributed facilitation

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## 1. Introduction

It is widely acknowledged that transitioning to food system sustainability requires multiple changes, through a coevolution of technological, social and institutional components, which in turn entails conducive cultural, legal and political environments. Among the many forms of transition that have developed during the last decades [1], the model of agroecology has been representing, over the course of its evolution, a promising integral option [2,3]. It looks at the food system as a whole, in all its components and its dynamic interrelations, as well as it takes into consideration all the needed changes to move towards sustainability, according to a system innovation approach. The concept of “ecology of the food system” [4] and the growing attention to the influence of social, cultural, institutional and political factors on the adoption of sustainable practices, well express the integrated view that has been increasingly characterising agroecology [5–7]. In addition, over its evolution, this model has been attaching a particular importance to three key components and their integration [2,3,8]: an epistemological approach oriented to knowledge co-creation (referring to 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 and integration of these three components and how they manifest—respectively, the participative-democratic approach

to new knowledge generation, the holistic and reflexive redefinition of practices, and the dimension of social and political engagement, empowering marginalised actors and aimed at promoting collective action towards significant system changes—are an expression of the comprehensive and normative approach to transition towards sustainability that characterises agroecology. Within the landscape of increasing diversification and re-framing of the agroecology approaches, this vision of agroecology emphasises its political potential [9–12].

This study aims at better understanding the processes underlying the implementation of the above mentioned agroecological approach and its political and transformative potential, focusing on the interactive and iterative learning that supports the development of new systems of knowledge, alignment around shared values and beliefs, and growth of collective reflexivity and agency. These outcomes are considered as vital to address the multiple dimensions involved in the needed changes, coherently with a systemic approach, at the same time allowing a wide social mobilisation to that effort. Looking at these processes, particular attention is paid to the mutual learning that stems from the encounter and interaction among different types of knowledge and to the development of reflexive and transformative learning from the shared experience. The collective dimension of these processes is considered crucial to the full expression of the potential for a socially led change. In that regard, the presence of a conducive environment, where these processes may take place—in other terms, conditions of environmental justice [13,14]—plays a key role, as well as the means by which to favour it [15–18]. By building on these assumptions and exploring them further, the study aims at improving the understanding of an issue that has been explored by other scholars in recent years, with similar aims and approaches [19,20].

The abovementioned processes are analysed through three case studies, located in Italy, concerning the reintroduction of agrobiodiversity within particular crop/food systems. Biodiversity-based farming and food practices are indeed an integral part of the agroecological transition project, representing the biological foundation of agroecosystem adaptive capacity. They also fully express some of its key features, such as the need to manage complexity and context-dependence, the socio-ecological system lens and the systemic approach, the knowledge and innovation co-generation, and the transformative purposes. Reintroducing agrobiodiversity indeed requires facing technical-technological, organisational, social, cultural, economic, institutional and legal challenges [21]. The changes involved and the related interdependencies require significant processes of new knowledge co-generation, values sharing and reflexivity raising [22]. They support the re-definition of practices, organisational models, relationships and communication involved in reshaping the production systems and the market valorisation. The development of collective awareness and agency is also crucial to a further mobilisation around agrobiodiversity, positioning this issue in more significant frameworks of meaning (e.g., farmers' rights, food justice, food sovereignty, commons) and in the policy arena (e.g., genetic resources regulatory framework) [21,23–29]. The development of these steps is demanding in terms of political re-framing and systemic view.

By means of a comparative analysis, the paper thus sheds light on the social learning processes underlying the re-introduction of agrobiodiversity and their effects in favouring the development of a systemic approach to the matter and of a transformative purpose/potential. To that end, it develops a framework to analyse the described initiatives by referring especially to the literature on the characters and potential of co-learning processes in social innovation aimed at transformations towards sustainability [30–32]. In a perspective of collectively driven processes and system innovation, it focuses on the enabling factors for this transformative learning. Intermediation, in its different forms, is assumed to play a key role for these processes to happen [33–38]. In this way, the study aims at contributing to understanding the conditions enabling processes of agroecological transformation of farming/food systems.

The following sections of the article introduce the theoretical background adopted in the study (Section 2), illustrate the empirical materials, the methodological approach and the analytical framework

(Section 3), briefly describe the studied initiatives (Section 4), analyse them through the defined framework (Section 5), and present some final remarks (Section 6).

## 2. Theoretical Background

The agroecology perspective well exemplifies the holistic and systemic view and the transformative approach that are necessary to address the complex challenge of transition to sustainable agro-food systems. In the perspective of socio-ecological systems, it looks at the co-evolution of biological components and human activities. As already introduced, it recognises that facing the adoption and consolidation of sustainable practices requires looking at the food system as a whole, taking into consideration all the different factors that intervene, from the very technical-technological aspects, to the social, cultural, economic, institutional and legal components. This spans the entire process, from the early stages of the production to the practices around final products [4,6,39], and refers to the single units of production and consumption as well as to the broader context of territories and networks where these are embedded [40]. It also demands to assume a multi-scale, political perspective, by connecting changes experimented at the local scale, based on the features of the specific contexts, to the needed changes at the global scale, namely in the politics that affects the world food system [6]. Indeed, within this multi-scale perspective, the three components of agroecology—the knowledge, practice and political commitment domains—take shape and develop their potential. Facing this complexity of domains and scales of (inter)action requires the development and sharing of new appropriate knowledge among the multiple actors involved, the alignment around common values and beliefs, and the arising of collective agency around an integrated set of goals, encompassing technical as well as social and political aspects.

In line with consolidated theoretical and methodological approaches to the transition to sustainable agro-food systems [30,32,38,41,42], the participatory approach of agroecology and its attention to context-specific processes see interactions that develop within multi-actor networks as a favourable environment for these knowledge co-creation and alignment processes [5,12,17,19,20,40,43,44]. 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 shared reflexivity [45,46] that is crucial to develop a transformative action [5]. 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” [8] (p. 42). The transformative learning that develops through multi-actor interactions is thus key to this political potential of agroecology.

As highlighted for other pathways towards agro-food sustainability [47,48], different forms and contents of knowledge as well as different value systems and visions are mobilised in multi-actor interactions. They include: traditional know-how in farming and processing, generally in the form of informal, experiential, integrative and situated knowledge; inputs coming from different areas of the scientific-academic research, formal and specialised; and knowledge on institutional and political issues developed by civil society organisations, together with claims that are expression of specific normative orientations [5,43,49]. Creating enabling conditions for this intercultural dialogue, within an inclusive, democratic and collaborative environment, is crucial. This means adopting (i) interdisciplinary approaches linking the different areas of research necessary for managing complexity, uncertainty and context specificity (e.g., integrating natural and social sciences [50] or in general combining diverse fields of competence), and (2), most of all, transdisciplinarity in the interaction among different kinds of knowledge and related actors, particularly practitioners and scientists. Concerning transdisciplinarity, the mechanisms enabling effective cooperation in the co-generation of knowledge are crucial [5,18,19,51,52]. In that regard, the relational dynamics that develop among actors play a central role in determining the outcomes of interactions [19,52–54]. Equally important is the evolutionary dimension: mutual learning that develops through interactions leads the involved actors’ understanding to evolve [19]; at the same time, along with these processes and the related changes in

capacities and attitudes, the actors' role may also evolve, giving rise to new potentialities [31]. An emblematic example is the one of the empowerment of farmers that is favoured by conditions of cognitive justice [16,55] and active engagement in research activities.

Together with the creation of a common pool of new knowledge to face all the challenges posed by the change, sharing new systems of values represents another essential condition. The adoption of a transformative perspective entails integrating a (shared) normative approach as a leading principle in the knowledge co-production and management, the re-shaping of practices and further engagement in collective actions. This step can be challenging both for practitioners, who need to develop awareness and willingness to do so, and for scientists, who, despite the non-neutral nature of their research, are not always able to orient their work to a transformative agenda, contributing to the processes that they study [52].

The social learning that develops in a multi-actor setting through iterative and dynamic interactions is central in these processes. It supports individual learning and allows aligning the views of different stakeholders, developing and actualising system thinking, and adopting a common transformative attitude. To that end, this learning shows the capacity to evolve from (i) a first order learning, which optimises practices and related modes of coordination based on experience, without calling the status quo into discussion, to (ii) a second order, reflexive learning, which questions assumptions and constraints and fosters the development of new patterns of thinking and action perspectives [56]. In so doing, social learning creates the conditions for more significant changes, as well as for a reflexive and dynamic approach towards the changes being made [31,32,54,57]. Crucial to this double-loop, transformative learning are those reframing processes—collective development and sharing of new cognitive and normative frames—that allow a radical shift in understanding and in value systems [58–60]. Common awareness, vision and attitude, and consequently coherence in action and coordination can develop from this learning, which thus becomes vital for innovation processes involving radical system-wide changes.

These co-learning processes are context-dependent, being strongly linked to the specificities of the contexts where understandings develop and evolve, to the features of the related relational environments, but also to the general culture and the systems of knowledge and values where actors and practices are embedded and by which they are conditioned. As said above, farmers' knowledge and value systems are largely the result of agricultural modernisation; this challenges the co-creation of new attitudes, beliefs and skills that support an agroecological transition, as it requires deeper changes, aimed at re-constructing farmers' identity, awareness, willingness to cooperate, and adhesion to different views and goals. To that end, the development of an alternative, favourable environment, involving primarily farmers but also all the other actors engaged in agroecological practices, becomes crucial; here, the collective processes of reframing can take place and trigger changes in ways of thinking and aspirations.

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 farming and food. In this same dimension, it also promotes interest in and agency for more significant system changes, a transformative objective to pursue through actions at higher levels of governance (the policy arena) or on cultural patterns (involving society at large). 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. Scholars analysing sustainability transition processes through the Multi-Level Perspective [37,61–66] consider these processes important factors in the consolidation of innovation niches and in vertical interactions between niches and regime [31,67].

The ways learning processes occur in reality may be quite diversified, as they may result from cognitive learning but also from experiential learning. The latter is a well-known mechanism among farmers [16,68,69], but it increasingly involves other actors, who question mainstream practices of food production or consumption. This foregrounds the issue of the recognition of these different

forms of learning and of the dynamics that develop in the real settings of learning among actors more familiar with one or the other mode. Other factors that may accompany and affect learning have a significant role too, such 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 farming and food practices, the great effectiveness of community-based social learning emerges, where change of actors' mindset benefits from the sense of belonging to a common pathway [48,70,71]. These factors also involve the special relationship that can develop between practitioners and scientists. Here, the development of trust, sense of reciprocity and mutually beneficial support in research practices, as well as a sense of solidarity and shared commitment to the cause, can be key distinctive features [19,52,54]. All of this confirms how relevant the social dimension of generation of new knowledge is, from the creation of a supportive environment, to the inner mechanisms of reframing, to the development of new reflexivity [54].

From all the above, the importance of some conditions emerges, such as enabling relational spaces and empowering processes which allow a factual involvement of all stakeholders, especially of those traditionally disadvantaged in the conventional system of knowledge creation-transmission. This refers to environmental justice [13,14], and, in particular, to conditions leading to cognitive justice, real participatory settings, equalised power relations and democratic governance of research [15–18,52,55].

Functions of intermediation are crucial in this regard. An extensive body of literature has been produced on intermediary actions, regarded as an essential factor of sustainability transition processes [72]. Looking more specifically to innovation in agrifood systems, the role of intermediary actions has grown in importance along with an evolution of the approaches to support innovation processes, which progressively moved from a linear, unidirectional model to a network-based, interactive and systemic model [30]. The urgent need for a transition to sustainable food systems has made these actions even more significant, as the key constituent of a participatory-empowering-decentralised approach and of a needed innovation systems perspective [36]. In this context, learning processes and the related actions of facilitation play a central role. At the same time, the complexity of the processes involved has been suggesting the need for a more advanced approach to intermediation, looking at a more articulated, phase-specific, interconnected and distributed function [32,35,36,38,72].

### 3. Empirical Material, Methods and Analytical Framework

#### 3.1. Subject of the Analysis

The manifestation of the abovementioned processes are taken into consideration when analysing initiatives aimed at agrobiodiversity enhancement, differently embedded within the holistic and transformative approach of the agroecology model. The analysis focuses on: the co-learning dynamics that underlie the processes of reorganisation around agrobiodiversity reintroduction; the related outcomes, ranging from the development of awareness on the meaning of agrobiodiversity to the growth of collective reflexivity and transformative attitude; and the conditioning factors. The objective is to improve the understanding of these processes and providing useful elements for refining research activities and forms of support.

The co-learning dynamics are analysed by investigating the changes involved in facing critical steps in the development of biodiversity-based systems:

- recognition of the values of “biodiverse” genetic resources and their introduction into farming systems, facing the constraints posed by seed regulatory frameworks; to that end, creation/strengthening of horizontal connections among farmers (in many cases weakened by agricultural modernisation);
- re-shaping and re-organisation of production systems through: actions involving skills and technology in breeding, cultivation and processing; definition of appropriate forms of coordination and organisational models to optimise the relationships among supply chain actors;

- cultural and economic valorisation of biodiverse products through suitable market channels and appropriate forms of communication to foster acknowledgement and appreciation of the multiple values of diversity-based farming/food systems and related products; at the same time, fair economic value distribution along the supply chain to assure economic sustainability to each value chain stage;
- adhesion to collective actions of enhancement of agrobiodiversity, aimed at sharing experiences and promoting new initiatives; this can occur at local level or by interacting with broader networks;
- mobilisation around social-legal-political issues, going beyond the mere production sphere to address the challenges linked to building alternatives to the dominant system of genetic resource management.

The unit of analysis is thus represented by the multi-actor systems involved in the reshaping of farming and food systems around biodiversity values. They include farmers and the other actors of the supply chain, consumers, and all the other actors that in different ways contribute to the process (including scientists, facilitators, advisors, non-governmental organisations (NGOs), civil society organisations (CSOs), and, sometimes, public authorities). Local farming/food systems are central in the analysed processes, as they represent the real world spaces where changes take place, through the interaction between practices and co-learning. Thanks to the networks in which these systems are embedded, however, the analysis extends beyond the local scale to involve broader contexts, from which important boosts come and where the innovation experimented at local level may contribute to trigger more widespread and significant changes.

The analysis proposed here re-reads through the illustrated perspective three case studies that were carried out from 2016 to 2017 within the EU funded project DIVERSIFOOD (H2020; [www.diversifood.eu](http://www.diversifood.eu)). The analysis was included in a first draft version of the article that was presented in 2017 at the 23rd European Seminar on Extension and Education (Chania, Greece): “Transformative learning: new directions in agricultural extension and education”. The case studies refer to three specific initiatives, taking place in Italy, aimed at rediscovering and valorising old varieties, landraces and populations of wheat for bread and pasta making, stemming from on-farm, participatory breeding—a breeding based on a decentralised and cooperative approach [73,74]. These genetic resources are significant within an agroecological transition perspective, as they are more suitable to organic farming, show greater adaptability to different and changing agro-environmental contexts, and present good nutritional-nutraceutical properties [21,75,76]. The three analysed cases were part of a set of eleven case studies, developed in eight European countries, referring to initiatives at different stages of development and involving different crops (wheat, vegetables) that had been identified as important for the various countries [77]. Improved agronomic performance in organic farming, environmental adaptability, processing and quality characteristics (healthy, nutritional, organoleptic) were the benefits looked for in these genetic resources. The development of local breeding/farming/food systems was considered the best way to fully and sustainably enhance their potential.

The farming systems analysed in the project as a whole show a different degree of implementation of the agroecological model, and the same is for the approach to agrobiodiversity. For some of them the agroecology model represents a consciously chosen goal, to be achieved through progressive transformation; for others this model is not yet fully defined, being often assimilated to a more sustainable model, which goes beyond the narrow and bureaucratic approach often taken for organic farming. For the former, the increase of cultivated diversity, in all its complexity, is an important step towards the agroecological model; for the latter, it contributes to trigger changes in the way of managing the cropping activities and the supply chain relations—changes which are however relevant in terms of potential for agroecological transition.

### 3.2. Methodological Aspects

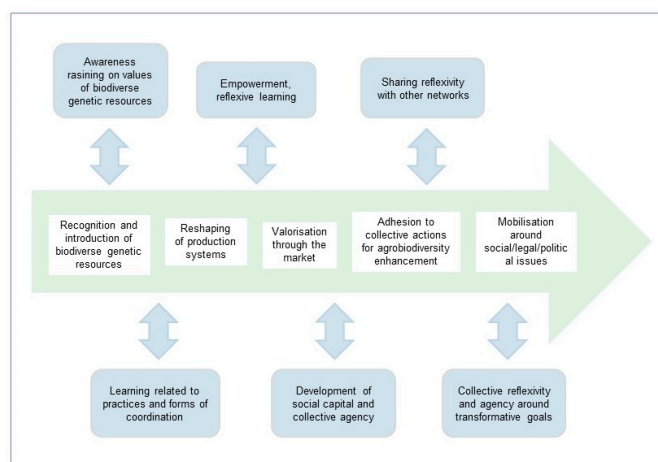
According to a constructivist and subjectivist methodological approach, the DIVERSIFOOD case studies were developed through qualitative methodologies and methods, suitable to grasp all the

social and economic aspects involved [78]. In that perspective, the case studies were conceived as investigations of a contemporary phenomenon in its real-world context [79]. All case studies followed a common workplan including four stages—organisation of data gathering, data collection and analysis, validation by people involved in the initiatives, and reporting—and common guidelines were provided to the national teams participating in the research [77]. The main tools for data collection were: consultation of grey and published literature and materials from Internet sources, and interviews with informed people to prepare a background analysis of the specific contexts in which the initiatives were embedded; semi-structured interviews with the various actors involved in the initiatives (farmers, breeders, millers, bread/pasta makers, retailers, intermediate users, consumers, scientists, facilitators, advisors, NGOs, CSOs and public authorities when involved); workshops to discuss and validate both the research design and the outcomes of the analyses; participant observation, attending various events and activities concerning the initiatives. The participatory methods adopted for the research design and the results validation mirrored the methodological approach defined and developed in the project, strongly oriented to implementing and refining multi-actor approaches [80].

In five of the eleven case studies, including the three selected cases analysed in this paper, a particular attention was paid to identify which social learning processes and related practices could best contribute to the recognition of environmental and social values of biodiverse resources, their integration in breeding, farming and food practices and, then, through building proper supply chains, their translation in economic values. The societal appreciation of biodiverse products was considered crucial to the maintenance of the production systems and of the diverse genetic resources they manage [81]. Furthermore, social learning and related growth in collective agency were considered key to address the institutional and political factors affecting agrobiodiversity management (seed market regulations, specific policies, power relationships). The three Italian initiatives were selected for this paper because they offered a greater amount of information on social learning processes, also thanks to the possibility of applying other methods of investigation, such as participating observation.

### 3.3. The Analytical Framework

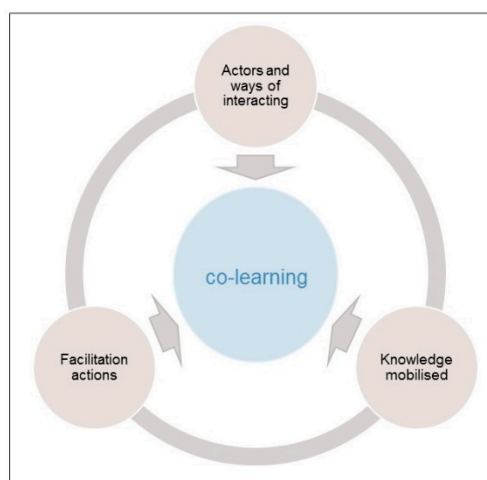
This paper aims to broaden and deepen the analysis of co-learning involved in enhancing agrobiodiversity, considering it as an interactive and iterative process that develops along with the actions carried out. The hypothesis is that such co-learning progressively fosters development of favourable attitudes towards agrobiodiversity enhancement, technical and organisational skills, social capital, shared reflexivity and collective agency. Potentially, by developing political awareness, it may also foster the adoption of a transformative perspective (Figure 1). Thus, it is about a co-evolution of learning and action, collectively experienced, with a significant transformative potential.



**Figure 1.** Co-evolution of learning (light blue) and action (boxes inside the green arrow) in the collective engagement around agrobiodiversity enhancement.

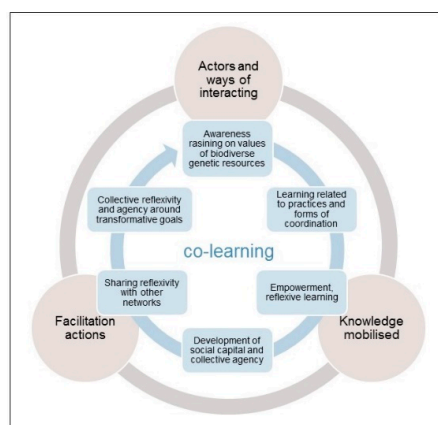
The analysis of these dynamics of inter-actions and learning and related potential involved in re-embedding agrobiodiversity in farming/food systems builds on the role, reciprocal articulation and cumulative effects of three elements (Figure 2):

- i. involvement of different actors and related ways of interacting, taking into consideration all the actors playing a role in the analysed processes and how they take part in these processes, including an evolution of their role and modes of interacting over time;
- ii. knowledge mobilised, taking into consideration all types of pre-existing, shared and co-created knowledge (e.g., experiential, contextual, informal, scientific, codified);
- iii. facilitation actions, carried out by actors institutionally recognised for their role of intermediation, but also by any other actor able to play such role.



**Figure 2.** Role of multi-actor interactions, forms of knowledge mobilised and facilitation actions in co-learning processes.

These basic elements, in the variety of features they may show and their evolving nature, are identified as the main factors that influence learning underlying multi-actor processes of co-creation of new awareness, knowledge and skills, attitudes, motivations, reflexivity and agency, needed to reintroduce agrobiodiversity in farming/food systems (Figure 3). Their nature and role, interdependence and cumulative effects on learning processes, in terms of enabling or hindering factors, constitute the analytical framework adopted in the paper, applied to the critical stages identified in enhancing agrobiodiversity.



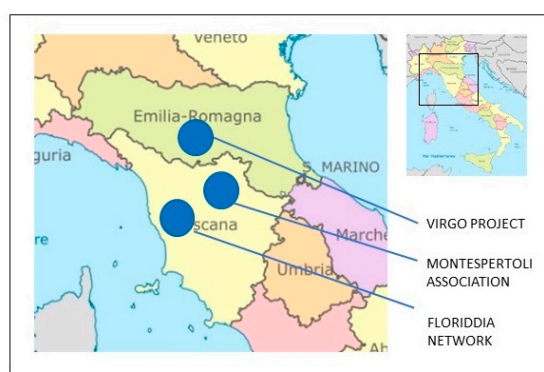
**Figure 3.** Action of multi-actor interactions, forms of knowledge mobilised and facilitation actions on co-learning processes.



#### 4. The Studied Cases

In this section, the three selected initiatives are briefly described following the analytical framework illustrated above, so focusing on the three main factors influencing the action-learning dynamics over the development of the initiatives (Figure 3), in all their critical steps (Figure 1). Although discursively, the descriptions highlight the actors involved, the relationships established among them, the interactions developed around knowledge sharing and creation, each actor's role and its evolution over time. After the case descriptions, Table 1 summarises the characteristics of the three initiatives for each critical step, to facilitate an overview. A deeper reading through the analytical framework aimed at foregrounding the potential of the learning dynamics on the development of the initiatives and the related mechanisms and enabling factors will be carried out in the following section.

Figure 4 shows the location of the three initiatives analysed on the Italian territory.



**Figure 4.** Location of the three initiatives analysed on the Italian territory.

##### 4.1. The Floriddia Farm and Its Network

Floriddia is a large-size (300 ha), family-run organic farm (here named with the owners' name) located in the hilly area of the Pisa province, in the Tuscany Region (Central Italy). Since 2009, under the guidance of the Floriddia brothers, the farm has been cultivating only traditional varieties and landraces and, more recently, mainly evolutionary populations of wheat, together with other cereals and in rotation with legumes. Evolutionary populations are characterised by a high level of genetic diversity, being a mixture of many different genotypes; their phenotype can evolve over time, adjusting to the different agro-climatic conditions. The motivation of this choice was the farm owners' desire to optimise organic farming, in order to redesign completely the farm activity in an agroecological perspective, and to improve the health and nutritional quality of food products (especially bread and pasta); all of this consistently with their strong commitment in terms of social responsibility. Hand in hand with this reshaping of farming, the farm has internalised the breeding process, investing also in technologically advanced equipment to reproduce (and sell) seeds of high quality. The equipment was built through close cooperation with a machinery manufacturer from the Emilia Romagna region, who was interested in fine-tuning advanced technology adapted to non-industrial, smaller scale activities. In 2010 the farm started processing (bread and pasta); it also started selling directly (through the farm shop and the local circuits of solidarity economy networks) and on local short channels (small retailers and restaurants).

Over the past years, the farm has been establishing close relationships with other local farmers, involving them in its breeding activities and production, or providing milling services or assistance for their breeding. A special legal agreement (named "network contract") was established to formalise the cooperation among the farms (it allows exchange of products and labour, sharing of machinery and equipment, and joint market initiatives keeping each individual status of enterprise). Cultivation contracts based on fair prices (steady and higher than the market prices) regulate the economic exchanges. More in general, the farm interacts actively with the other farmers, millers, bakers, and with

retailers, restaurant owners and organised groups of consumers (Solidarity-based Purchase Groups) who purchase its products. Many informal daily occasions allow meeting and exchanging experiences on wheat population characteristics (based on their stage or the particular environments), cultivation techniques and processing methods. Additional activities, such as demonstration events, farm visits, cultivation/bread-making trials and workshops on technical and legal-political issues organised at the farm, constitute other important opportunities. Communication is also intense with consumers, in a direct way (when selling in the farm shop, participating in product delivery, in field demonstration events and product testing events, with the farm monthly opening to visits) and mediated by the farm website. Particularly important relationships are those ones established with the Tuscan Network of Organic Farmers (CTPB) and, even more, with the Rural Seed Network (RSR). The latter is a national wide organization that since the early 2000s has been engaging in the promotion of agrobiodiversity management at farming level and in advocacy at political level, becoming a reference point for the issue in Italy and in Europe. Being a second level organisation, it includes about 40 other associations; in turn, it is a member of the European Coordination Let's Liberate Diversity! (EC-LLD), an important network active at international level. This organisation, in cooperation with scientists, has involved the farm in its research, training, animation and communication activities, making it an important place for trials, demonstrations and meetings, and, outside, a crucial node in experience exchanges. Through the cooperation with RSR or autonomously, the Floriddias also interact with various researchers, most importantly with: a geneticist from the University of Florence, long engaged with research on traditional wheat varieties; another well-known geneticist, now operating in Italy after years of international work on participatory plant breeding; rural economists of the Universities of Pisa and Florence, engaged in researches on sustainability transition of food systems; medical doctors investigating the health effects of consuming old wheat varieties and landraces; other actors who take part in research projects (European and local) which the farm has become involved in, including members of other networks engaged in agrobiodiversity issues.

Over the years, the cooperation with the above actors has greatly contributed to the evolution of the Floriddias' knowledge and expertise and, as a consequence, of their identity, status and commitment. Especially the cooperation with RSR has allowed broadening the vision of farming, which is now conceived under an agroecological perspective, going beyond the organic farming model itself, and being deeply integrated in the local social context (as provider of knowledge, services, labour and good food). Furthermore, by connecting the farm experience with that of other members of its own network engaged in innovation in agrobiodiversity management (at local and national level, but also at international level), this relationship has integrated the farm into a broader collective action aimed at advocating for farmers' rights in seed management. Part of this vision is the initiative to start selling seeds from the evolutionary populations with which the farm has been experimenting. This is made legally possible thanks to the formal recognition of the possibility for farmers to sell seeds under certain conditions, as well as to the registration of some wheat populations under a temporary derogation to the current seed marketing regulation (Commission Implementing Decision 2014/150/EU, referring to the period 2014-2018, further extended to 2021; it aimed at assessing the feasibility of registration, on-farm production and marketing of seeds from so-called "heterogeneous genetic materials"). The Floriddias' idea, shared with RSR and other networks, is to create an alternative seed system, emancipated from the conventional seed market and able to provide local farming systems with seeds of varieties or populations suitable to the specific characteristics of the local agro-environments and able to co-evolve with these over time. This objective is part of the shared project to reshape seed management and related farming systems on a territorial basis, into a perspective of community management.

#### *4.2. Heritage Wheats of Montespertoli Association*

The "Heritage Wheats of Montespertoli" Association (HWMA) was founded in 2010 and formally established in 2014. It is based in the small town of Montespertoli, located in a hilly area close to Florence (Tuscany Region, Central Italy). It runs a locally based supply chain that goes from the seed

production and cultivation of old varieties of wheat to the commercialisation of bread. It includes about 40 farmers (who cultivate a surface of 200 ha with these wheat varieties), a miller and two bakers. Seed production is internalised on the farms and is collectively managed by the Association; both the production and reproduction activities are annually planned collectively through the help of an agronomist. Farmers adopt the organic method; however, some of them avoid the conventional certification system. To face this aspect and increase the network cohesion as well, a participatory guarantee system, under the supervision of the agronomist, has been set up; this has contributed to enriching the interactions among farmers and strengthening the engagement of all the actors involved in the project. The association has also defined a code of practice, which establishes operational rules and regulates the exchanges across the production process; a trademark, referring to the locality of Montespertoli, is then used by bakers on the final products. The produce is sold mainly locally, in the Montespertoli area, in bakeries, specialised shops, small supermarkets and a school canteen. An agreement aimed at guaranteeing fair and sustainable prices along the supply chain has been crucial for its development: the grain is bought from the farmers at a higher price than the price on the conventional market; the consumers buy the bread at a low price considering the quality of the product.

The initiative was promoted by the miller and one of the two bakers, who both had great experience in the field and wished to revitalise the local traditional bread production. The interest in heritage varieties came later, after having met a geneticist from the University of Florence, who explained to them the agronomic, health-nutritional and organoleptic characteristics of the old varieties and helped introducing these varieties in the farming practices. The agronomist played a key role in the interaction between this scientist and farmers. The collaboration with the scientist was also crucial to start rediscovering traditional ways and means for milling and baking (stone milling and sourdough for traditional bread making). The continuative, daily interaction between the miller and the baker, and the related exchange of their expertise, allowed fine-tuning the processing practices, e.g., adapting kneading equipment and techniques, and managing the variability of the flour characteristics.

The initiative progressively involved other farmers, leading to the creation of a consolidated network. The agronomist and the scientist worked also to bridge HWMA with other actors working on traditional varieties, for example agricultural economists from the University of Florence. The connection with RSR (through the agronomist) was also meaningful for the early development of the initiative, although the actors involved did not join RSR activities in a continuative way and HWMA has not adhered to the seed networks as a formal member. A significant role was also played by the Municipality administration, which contributed to kick-starting and consolidating the initiative, supporting the institutionalisation of the HWMA activities (e.g., the formal establishment of the association; the achievement of the collective trademark), promoting it locally (e.g., by introducing the bread in the local school canteens) and giving it visibility outside, by participating in/organising official events. The territorial focus represents a strong element of cohesion within the organisation, where it has supported the revitalisation of the production system (including recovering of knowledge and skills); it is also a strategic marketing factor, aimed at conveying the intangible and tangible values of the bread (local traditional heritage, nutritional value, environment preservation, local identity) to the people living in the Montespertoli area.

#### 4.3. *The Virgo Project*

The Virgo project was developed through a formal collaboration between a group of biodynamic farmers, located in three provinces of Emilia Romagna Region (Northern Italy), and a scientist (agronomist) from the University of Bologna, working, with other colleagues around Italy, on the nutraceutical and technical features of old wheats varieties. Funded from 2013 to 2015 by the Regional Government, the project represented the continuation of a similar research project around bread funded from 2009 to 2012 (*Bio-Pane* project), based on five traditional wheat varieties, cultivated organically. The project had seen five farmers and a bread-maker playing an active role in running the various experimentations in collaboration with the University. All the participants were moved by the idea that

cultivating and processing old wheat varieties and selling products directly in short circuits could be an opportunity to safeguard consumers' health and ensure fair incomes to small farmers, emancipating them from the instability and lack of recognition of the mainstream market. During this first project, farmers did field experiments on five old wheat varieties; some baking experiments were also done. This collaboration allowed: understanding more about the technical and nutraceutical features of the old wheat varieties; reproducing a sufficient quantity of seeds for both production and research purposes; starting a short chain for flour and bread; and defining guidelines to regulate the exchanges within the association and the production process. All this provided knowledge, social capital and a practical basis for the development of the second project.

The aim of Virgo project was experimentally assess the agronomic and processing performance of the wheat varieties mixture and their evolution over time. One farmer in particular has taken a leading role within the group of cereal growers, contributing significantly to their engagement and the development of the initiative. He made investments to internalise all the steps of the production process, including the cleaning of seeds, milling and bread making, in many cases experimenting to fine-tune the equipment. He provides services to the other farmers (e.g., for the cleaning and milling), and these activities allow informal exchanges of information and experience on plants and their characteristics. The farmers remain, however, independent in their activities of production and selling; the latter are managed locally through farm shops, online shops, buying groups, farmers' markets, and medium-sized shops specialised in organic, high quality products. A strict production protocol was defined to coordinate the activities; based on it, a collective trademark was created for the flour and the bread, although it has not been utilised so much by the other farmers due to the local scale of the commercial exchanges. Although the number of farmers and processors involved increased a little over the years, the Virgo project has remained of limited scale and territorially based (it involves ten farmers, cultivating 20 ha of wheat).

The leading farmer was the initial connection point for the University and bridged the relations with the other farmers. He also contributed to the establishment of a relationship with RSR, which provided him support in organising local awareness raising events involving other farmers and other supply chain actors (e.g., demonstration events, farm visits). The researcher from the University of Bologna was collaborating with RSR in European-funded research projects; this provided the initiative the opportunity to be involved in broader networks, although only the leading farmer took part in these exchanges.

The project has then reached a turning point: the scientist would like to expand it, in order to upscale the supply chain and reach a higher number of consumers, while the farmers want to maintain a network-based, community dimension, keeping control on the system of biodiversity management created and a close relationship with the local consumption circuits.

As previously mentioned, Table 1 summarises the characteristics of the three initiatives in each of the critical steps addressed when reintroducing agrobiodiversity.

**Table 1.** Summary of the characteristics of the three initiatives in the various steps.

	Floriddia	HWMA	Virgo
<b>Recognition and introduction of biodiverse genetic resources</b>	<ul style="list-style-type: none"> <li>• Introduction of old varieties and then evolutionary populations through collaboration with two scientists and two civil society organisations (CTPB*; RSR**).</li> <li>• Engagement in breeding.</li> <li>• Involvement of other local farmers.</li> <li>• Exchanges in broader networks.</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of old varieties through collaboration with a scientist and an advisor.</li> <li>• Collective management of seed reproduction.</li> <li>• Collaboration within a small network of farmers.</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of five old varieties through collaboration with a scientist.</li> <li>• Engagement in breeding.</li> <li>• Collaboration within a small network of farmers.</li> </ul>

Table 1. Cont.

	Floriddia	HWMA	Virgo
<b>Reshaping of production processes</b>	<ul style="list-style-type: none"> <li>Engagement in experimentation with cultivation and processing activities (reintroduction of traditional techniques for milling, kneading, leavening, pasta drying, but use of advanced equipment).</li> <li>Production of a wide range of products.</li> </ul>	<ul style="list-style-type: none"> <li>Initial engagement in fine-tuning cultivation and processing activities (reintroduction of traditional techniques for milling, kneading, leavening; adaption of equipment).</li> <li>Bread production.</li> <li>Definition of a code of practice.</li> </ul>	<ul style="list-style-type: none"> <li>Initial engagement in fine-tuning cultivation and processing activities (reintroduction of traditional techniques for milling, kneading, leavening; adaption of equipment).</li> <li>Production of flour and bread.</li> <li>Definition of a code of practice.</li> </ul>
<b>Valorisation through the market</b>	<ul style="list-style-type: none"> <li>Direct sale (in the farm shop and through the local circuits of solidarity economy) and sale on local short channels (small retailers and restaurants).</li> <li>Fair economic contracts with grain providers.</li> <li>Interaction with RSR to create a label for the population seeds, able to convey information on their origin and on meanings and implications of their use.</li> </ul>	<ul style="list-style-type: none"> <li>Local sale by the processors, through small bakeries, specialised shops, small supermarkets and a school canteen.</li> <li>Creation and use of a collective trademark.</li> <li>Emphasis on territorial identity.</li> <li>Fair distribution of economic value along the supply chain.</li> </ul>	<ul style="list-style-type: none"> <li>Individual direct sale by farmers or small processors, through farm shops, on-line shops, buying groups, farmers' markets, organic specialty shops.</li> <li>Creation of a collective trademark (however, not used yet).</li> </ul>
<b>Adhesion to collective actions for agrobiodiversity enhancement</b>	<ul style="list-style-type: none"> <li>Interaction with other local farmers and institutionalisation of the collaborative relationship through a formal agreement.</li> <li>Interaction with many networks engaged in agrobiodiversity issues, at local and broader level.</li> <li>Role of leader in working on agrobiodiversity, recognised locally and shared with other farmers at national level.</li> </ul>	<ul style="list-style-type: none"> <li>Establishment of the Association operating at local level and including farmers and processors.</li> <li>Farmer adhesion to the project built around old varieties supported by the leading roles of the miller and the technical adviser.</li> <li>Agrobiodiversity enhancement used as a tool to revitalise the local production system and as an element to build the marketing strategy.</li> <li>No adhesion to broader networks.</li> </ul>	<ul style="list-style-type: none"> <li>Farmer engagement in the collective project built around old varieties. Establishment of internal rules to manage the territorially scattered system.</li> <li>Agrobiodiversity enhancement used as a tool to improve performance of organic/biodynamic farming and to become emancipated from the conventional seed market.</li> <li>Individual relationships of the leading farmer with RSR.</li> </ul>
<b>Mobilisation around social/legal/political issues</b>	<ul style="list-style-type: none"> <li>Strong commitment to the cause of biodiverse farming and food.</li> <li>Active involvement in the legal management of population seed (among the first to register populations in Italy).</li> <li>Engagement in education and dissemination activities to other practitioners and consumers.</li> </ul>	<ul style="list-style-type: none"> <li>No particular engagement around legal and political issues.</li> </ul>	<ul style="list-style-type: none"> <li>Interest for seed/food sovereignty issues but no particular engagement around legal and political issues.</li> </ul>

\* CTBP, Tuscan Network of Organic Farmers; \*\* RSR, Rural Seed Network.

## 5. Analysis

The three studied cases provide interesting insights on the nature and role of learning processes that develop through interaction within multi-actor networks and on the related enabling/hindering factors. These aspects are analysed in the two following sections. According to the analytical framework adopted, both take into account the main factors that intervene in the development of co-learning: actors involved and their ways of interacting; knowledge mobilised; and facilitation actions carried

out (Figure 2). These factors are, of course, closely related; however, for clarity, they are analysed in two distinct paragraphs. The first paragraph focuses on the development of co-learning processes involved in addressing reintroduction of agrobiodiversity, looking at the need for new knowledge, and at its generation through intersection of different types of knowledge and the creation of shared knowledge. To make the analysis more effective, these processes are read in the settings where they take place, namely, the main steps of the initiatives. The second paragraph focuses on the ways by means actors interact contributing to co-learning, often mediated by the actors' attitudes and by the evolution of these along with mutual learning, and on the role of the function of facilitation of this interactive learning carried about by some of the actors. These factors are read in a cross-cutting way with respect to the various steps.

### *5.1. Sharing and Co-creation of Knowledge in Understanding and Handling Agrobiodiversity*

The studied initiatives highlight the significance and complexity of co-learning processes that intervene, indeed interesting all the involved steps as illustrated in Figure 1 and Table 1: the introduction of old varieties, landraces or populations; the management of their farming and processing; their marketing in short supply chains and the related communication activities; the adhesion to/development of collective actions around agrobiodiversity; and the awareness raising on social-legal-political issues and related mobilisation. Co-learning leads to the creation of new, shared knowledge, which is essential to change practices and reshape farming/food systems, but also to develop the greater capacities and reflexivity needed to face the many challenges posed by agrobiodiversity reintroduction and enhancement.

#### *5.1.1. Recognition and Introduction of Biodiverse Genetic Resources*

Co-learning processes prove to be significant for the approach to the biodiverse genetic resources and its reintroduction. The understanding and acknowledgement of the value of old varieties and landraces, as well as the development of possibilities and willingness for their diffusion constitute first important challenges to face. These processes of course see a central role for farmers. However, in the contexts taken into consideration, they appear not to build directly on farmers' knowledge and know-how. Differently from other contexts (e.g., some Southern countries), and considering in particular young or middle-aged people, after decades of agroindustry-integrated farming, farmers do not seem to have a particular awareness of implications of crop choices in terms of biodiversity, neither a wealth of experiential knowledge to recover or use [22]. In this respect, the inputs coming from scientists, advisors and organisations engaged in agrobiodiversity issues prove to be key to support actions and trigger learning. They create conditions for operationalising the adoption of otherwise neglected genetic material, making it possible to access the seed in practical terms, and, even more importantly, overcoming the cognitive, cultural and legal barriers (examples of facing legal barriers are the actions carried out to take all the opportunities that over time have emerged to overcome the constraints stemming from the seed regulatory system, such as the derogations introduced for conservation varieties or for heterogeneous materials). The consultancy provided was indeed crucial to make the biodiverse varieties known (in their existence and for their properties), start experimenting with them and, then, adopting them. The civil society organisations, in particular, hand in hand with supporting farmers in experimentation, foster reflexive learning, broadening the meaning of working on biodiverse genetic resources and reframing the practices in political terms. The interaction among practitioners, on its side, strengthen these processes, giving them a collective dimension and so contributing to their legitimisation (a sort of recognition from within the farmers' community) and to their horizontal spread. A new collective identity and a strengthened role for cereal farmers arise from these socially experienced processes. At the individual level, the shared awareness and the development of autonomous capacity in managing and experimenting with unconventional genetic material represent an important, further achievement in this process: the integration between the new inputs and farmers' accumulated and empirical 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 case is emblematic of these processes. The convinced adhesion first to the use of landraces and then of evolutionary populations, to the point of converting the entire farm land, has gone hand in hand with the growing understanding of the related crop system value, perfectly fitting the farmers' ideal of an agroecological, multifunctional farm and of a socially recognised role for farming. Here, the cooperation with RSR and the geneticist is fundamental. The mutual learning stemming from this interaction provides a fertile ground to take a wider view of the role of agrobiodiversity in farm practices and to move forward in innovating with plant breeding. The introduction of evolutionary populations is particularly meaningful because of the potential of this genetic material in terms both of increase of farming systems' adaptability and of farmer empowerment: the farmers' capacity to understand this potential is crucial. An additional result of this learning process is the willingness of the managers of the Floriddia farm to play an active, pivotal role also in promoting the diffusion of the varieties/populations among other farmers and processors. Moreover, new relationships with other scientists are established to deepen knowledge about the health properties of the genetic material used. In the Virgo case, the farmers' growth in awareness and experience around old varieties, combined with a strong identity as a farming community (biodynamic agriculture), has led to the definition of a specific strategy, independent from the one defined by the University, which has come to be gradually perceived as misaligned with their vision. In the Montespertoli case, the rediscovery and reintroduction of traditional varieties have taken the form of a collective project, which has led the local farmers to join around a new motivation and, through the connection with the territorial identity, has allowed the development of an entire production-consumption system.

#### 5.1.2. Reshaping Production Systems

The generation of new knowledge and shared views is significant also for the adaptation of farming practices (e.g., cultivation techniques, crop rotations, seed conservation) and processing technology (e.g., milling, kneading, leavening, pasta drying), which has posed significant challenges, requiring the development of new skills and proper equipment. In the case of cultivation practices, the reintroduction of biodiverse varieties, although fitting the needs of organic farming, proves to be complex, because of the need not only to adopt different techniques, but also to face all the specificities and uncertainties stemming from each agro-environmental context. In the case of cultivation of evolutionary populations, this aspect is particularly significant since the crop is dynamically evolving, thus resulting even more demanding in terms of farmers' capacity to develop relevant skills. Similarly, processing requires adaptation to the different performance and variability of the raw material: millers', bakers' and pasta makers' competences and skills are again central to manage and valorise the "diversity" of the flour. Furthermore, and more in general, biodiverse products have to meet users' and consumers' needs and taste, while also requiring a capacity and willingness by these to adapt their cooking methods and habits.

The need to reshape farming/processing technology sees a fruitful integration between, on the one hand, the codified scientific and technical knowledge (from scientists, advisors, equipment manufacturers/suppliers) and, on the other, practitioners' experiential knowledge. This integrated knowledge is subject to further refining through the new empirical learning that follows its practical application. This shows there is no passive acceptance of external expert knowledge and that the learning process is continuous, through the iterative relationship between knowledge and practices. This process furthermore involves not only practitioners' knowledge but also scientists' knowledge; both are involved in learning and in the process of co-innovation. The result is that the practitioners achieve full control on the "new" process, and the latter substantively reinforce their knowledge.

The Floriddia and Montespertoli cases are representative of these processes. The Floriddias' choice to convert to populations has required a significant investment in creating new knowledge; here, the support from the geneticist and RSR has been crucial, complementing the farmers' long experience; as

well, the farm development in terms of techniques and equipment has built on the interaction with the geneticist's and machinery manufacturer's expertise. The result of this process is a growth in competence that involves all actors and that seems to show further potential, as shown by the Floriddia brothers' engagement in disseminating knowledge on the biodiverse varieties and/or populations among farmers, other practitioners and consumers. The Montespertoli production system has seen the key contributions of the geneticist and the advisor, but the miller's and the baker's considerable expertise have been essential to fine-tune the process.

Sharing new knowledge and alignment around common values and motivations prove to be important also for the definition of common rules and norms, which in turn may translate into forms of coordination along the supply chain or within the network. This assures a good functioning of the collective projects and supports the development of a common view of the actions undertaken, so creating conducive conditions for the further development of collective agency around shared goals.

Although in different ways, all initiatives showed the importance of these processes, in the farming practices and, then, in the functioning of the entire supply chains, e.g., in seed and products management, use of quality signs for final products, fair economic value distribution, implementing of alternative organisational models. The institutionalisation of the relationships between the Floriddia farm and the local farmers, the production planning and the code of practice for the use of the collective trademark for the Montespertoli bread, and the rules governing the Virgo initiative, which involves farmers belonging to the same (biodynamic) community but scattered across the territory, are examples in this sense. Beyond sharing of knowledge, the degree of alignment around values and beliefs affects the process of co-creation, alternatively supporting consolidation or generating divergences or conflicts among actors. In the Floriddia case, the shared commitment to the cause of agrobiodiversity enhancement has allowed the farm to extend its activities beyond the farm gate, giving rise to a broader system, aimed at facing all the challenges (starting from the legal constraints around seed marketing). In the Virgo project, the lack of a common view about the potential of the system created and its future developments between farmers and researchers has had disruptive effects.

### 5.1.3. Valorisation of Biodiverse Genetic Resources through the Market

Learning is also at 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 re-production of the entire production system. Here, the new knowledge and attitudes developed among the actors involved in production come into play in the relationships established with retailers, intermediate users and final consumers, triggering new mutual learning. These involve technical-practical aspects (e.g., type of the raw materials, type of processing, modes of cooking, health-nutritional properties), but also economic aspects (the meaning of a higher price), and more "political" aspects, related to the implication of the turn to the biodiverse varieties in terms of agroecosystem resilience and agricultural and food sovereignty.

The three initiatives show different modes and effectiveness in conveying the meanings of agrobiodiversity, in order to obtain consensus on these and create alliance with the other chain actors and final consumers. These mirror the form/degree of engagement around the issue. In this regard, the Floriddias' engagement in interacting with retailers, restaurant owners and consumers seems very effective in communicating the "meaning" of these crops/products, involving the potential users in knowing and experiencing their characteristics directly. Moreover, their strong commitment has given rise to a significant symbolic/reputational capital, making the farmers' activities even more effective on a large (although local) territory. Who consumes their products knows what there is behind them. To maintain this, the farmers do not want to expand the farm market further. In the Montespertoli case, the specific features of the wheat production are used to create the territorial identity at the basis of the marketing strategy; the collective trademark is well known in the local community. However, the agrobiodiversity message appears quite weak here. In the Virgo case, the short supply chains



created around the production system build on the shared knowledge of the product values. This makes additional tools, as the trademark, seem unnecessary.

#### 5.1.4. Adhesion to Collective Actions and Further Mobilisation around Social/Legal/Political Issues

As already stressed, learning processes can develop within relational structures that extend beyond the farm and supply chain boundaries, as well as beyond the local context itself, within broader networks. Both dimensions prove to be important to evolve in agrobiodiversity management, to develop collective agency and promote further mobilisation aimed at carrying out political actions. Because of the interdependence of these interactive dimensions and of their outcomes, they are here analysed together.

The first dimension refers to an innovative approach to agrobiodiversity management, based on the active involvement of and interaction among farmers and other chain actors, but also on the cooperation with other knowledge-holders and on the involvement of local communities. Other actors may indeed be bearers of crucial knowledge inputs or opportunities, and this strengthened interaction may contribute to create a conducive environment to further advancements in agrobiodiversity reintroduction and to further empowerment of the actors directly involved. This represents a significant evolution if compared with the conventional practices of agrobiodiversity conservation (including in situ conservation): it builds on a collective and dynamic management of agrobiodiversity, strongly based on co-generation of motivations, goals and capacities, involving farmers and the related communities [21,82,83].

In the Floriddia case, hand in hand with the growth of the experience around evolutionary populations, the integration between the farm and the surrounding environment, building on relationships in which material and immaterial resources are exchanged (e.g., seeds, raw material and products, labour, information, know-how, motivations, visions, openness to innovation), has given rise to an expanded, open model of farming activity, embedded at territorial level. Conditions seem to emerge here for evolving towards a community management of agrobiodiversity, where the last one is increasingly taking on the meaning of a commons. As a crucial step in the re-appropriation of control on the entire production system, the project to develop an alternative local seed system, run in cooperation with other farmers, is emblematic of the potential of this approach. In the Montespertoli case, the identity component, referring to the locality and its heritage of bio-cultural resources, is a key constituent of the initiative. It has allowed the revitalisation of the production system, giving the involved farmers and processors a new role, socially recognised, and it has provided the framework for the development of a well organised system, integrated in the local context. However, the pre-eminence of the marketing strategy has led this system to evolve as a localised, closed system, without many exchanges with the outside, and this has reduced its impact. The Virgo network shows a strong commitment towards agrobiodiversity and has defined strict rules to manage the supply chains consistently, in order to keep the core values of the production system intact; however, again the rather closed character of this system, apparently aimed at defending its niche positioning, appears to weaken its potential.

Starting from the exchanges taking place in localised initiatives, interactions within broader networks prove to be supportive to grasping additional opportunities and, more in general, to widening horizons, seeing the reintroduction of agrobiodiversity as part of a wider reorganisation of farming/food practices, that demands significant socio-cultural, legal and political changes. This broadening of spaces and processes of learning is crucial to develop willingness and capacity of mobilisation. Sharing reflexive thinking within other networks favours the growth of awareness and collective agency, which help to relate the initiatives undertaken to broader projects and may lead local networks to engage in further efforts for change. To that end, networking allows accessing other important resources, such as information, public funds, new relations, joint projects, and new perspectives. These processes are evident in the Floriddia case, where the farm, besides interacting intensively at local level, is an important node of a wider network at national level (RSR), which in turn

interacts at international level (e.g., within EC-LLD). Significant collaborations have developed within these networks, as those around research/experimentation on crops and organisational models (in local, national and European projects), or in terms of advocacy around the issues of seed sovereignty and implications linked to the seed regulatory framework.

### 5.2. *The Role of Modes of Interacting and of Facilitation*

The ways in which different actors, carriers of different knowledge and visions, interact are, as said, crucial to the process of co-creation of new awareness and motivations, knowledge and reflexivity, autonomy and agency around agrobiodiversity issues. Confirming what has been highlighted also by other studies [16,19,52], the empirical evidence shows in this regard how much establishing collaborative, equal and trust-based relationships may be fruitful. This concerns all the involved actors; however, this potential is particularly evident in the relationships between scientists and practitioners. Indeed, the researchers' ability to make their expertise available within an equal relationship affects the development of mutual learning strongly. The cases analysed show that also the creation of new scientific knowledge may be inclusive and participatory, allowing to overcome the socio-cultural hierarchies and institutionalised asymmetrical power relations that often characterise research, thus enabling conditions for collaborative learning. The capacity to create conditions of environmental justice [13,14] and, in particular, conditions assuring cognitive justice and democratic governance of research [15–18,52,55] confirms to be crucial. This means guaranteeing recognition of practitioners' experiential and situated knowledge and their real participation in all the phases of the research, from identification of the problem and related research question and, in the operationalisation of the research activity, from design to assessment of outcomes. In such a context, scientists seem to participate in generating new knowledge together with practitioners, as "co-researchers". As seen in the previous paragraph, this emerged particularly for plant breeding, but also for the processing technology or nutraceutical properties of products.

Consistently with the agroecological dimension and, within this, the approach necessary to manage agrobiodiversity, the researchers' capacity to adopt a holistic approach to the socio-ecological systems they interact with, avoiding specialisation and rather embracing all the needed dimensions of change, is another crucial factor. The sensitivity towards social and cultural aspects (e.g., farmers' identity, prejudices, and ignorance about seed regulations, consumers' food habits), as well as economic and legal implications (e.g., crop uncertainty, market risk; understanding and managing opportunities, avoiding illegal actions) is an added value in promoting and supporting technical innovations. Not less importantly, the adoption of a clear normative stance on the issues faced is a substantial component of the trustful relationship that researchers establish with the other actors. Indeed, it is associated with a strong commitment to the cause [52]. All these aspects show their importance in the analysed initiatives, both when they constitute conducive factors, as in the Floriddia case and, although to a lesser extent, in the Montespertoli case, and when they refer to hampering factors, as in the case of Virgo, particularly for the weakening of the relationship of trust between the farmers and the scientist due to the latter's change of vision and goals.

In addition to the importance of modes in which the different actors interact, often mediated by their personal attitudes, the evidence confirms how greatly mutual learning processes benefit from the presence of facilitation actions. The study adopts this term, preferring it to that of intermediation, because it is more effective in representing the complex function performed. The initiatives analysed show that the kind of help needed to support processes of knowledge raising and mobilisation around agrobiodiversity includes assistance at a technical, organisational and legal level, bridging different types of knowledge and experience, or supporting access to special resources, but also, and even before, social and cultural animation aimed at fostering networking and interactions, openness to knowledge exchange, and development of a broader perspective. It also includes more complex empowering actions, aimed at overcoming situations of environmental injustice due to cultural subordination and asymmetry in power relationship. RSR's role is emblematic in this regard: it has been supporting

individual and collective process of growth through learning, by (i) acting as intermediary between the various actors/networks and the related knowledge forms, facilitating the mutual learning stemming from these exchanges, but also the consolidation of the related outcomes in the specific social and environmental contexts; and by (ii) fostering the integration among different areas and scales of action, from technical to juridical and political domains, and from local to global scale. As more in general in the agroecological model [20], the capacity to adopt a system vision and a multi-scale approach is central in dealing with agrobiodiversity issues. In this perspective, RSR's facilitation action is aimed at creating horizontal and vertical cross-connections [1]. 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 (reflexivity) and governance, thus positioning locally based initiatives into broader frameworks of meaning and collective agency (such as seed legislation, farmers' rights, food sovereignty), where the experience gained through practices and the consciousness and motivations shared through interactions are mobilised in the policy dimension. The benefits of this facilitation action emerge clearly in the Floriddia case, where the degree of collective reflexivity among all the actors has been increasing. The work on evolutionary populations, hand in hand with the opening process in the regulatory framework at EU level (in itself a result of the advocacy action by organisations such as RSR), and the other initiatives promoted to increase autonomy in seed management at the local level are emblematic in this sense. On the contrary, in the Virgo case, the lesser importance of facilitation may in part explain the local network's difficulty to see its own project as part of a broader project and the arising of disagreement with the scientist co-promoter of the project. A support aimed at facilitating, since the beginning of the project, an interaction among the two parts to discuss the respective interests and goals and, possibly, agree on a shared perspective might have helped avoiding the dis-alignment of the actors involved and maintaining the project potential. In the Montespertoli case, facilitation has been managed by an advisor and has been mainly aimed at supporting the organisation of the local production system. The choices related to the genetic material—centred on old varieties, managed in a not evolutionary way—are instrumental to improve the quality and visibility of the product, within the marketing strategies. Implementing more sustainable agro-food systems, broader networking and further transformative goals seem to be less important here.

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

The role that learning processes and related mechanisms play for transition to sustainability is widely acknowledged, both in the research 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 processes can improve.

This study first confirms the recommendation that measures and actions to create supportive conditions for learning should primarily facilitate networking and, through it, interactive and iterative processes of thinking and action. The analysis has explored the role, mechanisms and potential of co-learning processes occurring within these multi-actor networks, uncovering particular enabling and hindering factors. Among the former, it confirms how much important facilitation actions are. The presence of these actions can make the difference, supporting co-learning among the various actors and, through it, alignment processes, adoption of systemic approaches, development of collective agency and broadening of horizons. In this way, mutual learning can take on the character of “transformative learning”, so important in processes of transition to sustainability, as in this case agroecology.

However, the complexity of mechanisms ensuring effectiveness of co-learning and facilitation that the reality shows seems even greater, pointing out the need for deeper understanding and adequate forms of support.

The analysis highlights how knowledge creation may evolve along with the learning processes, thanks to progressive accumulation of knowledge and different orders of learning. As stressed, this evolving character of knowledge development is significant in pathways aimed at a transformative

action, such as agrobiodiversity reintroduction and, by definition, agroecology; here, the innovation in practices integrate with knowledge co-creation but found a crucial constituent in collective mobilisation and commitment for system change [2,3,5,8]. The analysis also shows that the development of knowledge may be quite articulated and generate synergies. It emerges that within learning networks characterised by close internal interaction and engagement in mutual learning, individual actors, over time, develop a capacity to handle the common pool of knowledge actively, thus contributing to multiply the poles of creation, spreading and application of knowledge. When considering the role of actors traditionally not considered as promoters of knowledge creation and dissemination, as farmers, the analysis has shown the importance of the existence of leaders that, within favourable conditions, can acquire a prominent role and facilitate collective learning. However, the evidence also shows that the outcomes of this function are strongly affected by the leaders' breadth of interests and horizons, and by their openness to learning, innovation and networking. Moreover, the leaders' capacity to promote other actors' participation and growth, acting as catalysts, emerges as an essential element. Also, these attitudes are linked to the degree of embeddedness in collective learning. Maintenance of a high level of interaction, within and among networks, and facilitation of effective co-learning so seem crucial to exploit all these potentials.

In addition to confirming the complementarity between formal and informal knowledge [48], another significant result is the re-allocation, on the one hand, of formal knowledge generation, no more prerogative of scientific institutes, according to a model of decentralised research; and, on the other hand, of informal knowledge generation, involving all the actors, from farmers to scientists, around the iterative dynamic of practice and learning. In the words of Blackstock and colleagues, this seems to take the shape of a "co-generation of knowledge about socio-ecological systems drawing on multiple understandings in an ongoing collective dialog in order to transform practice, where academics and stakeholders are all co-researchers" [84], quoted in [8], p.2. The analysis has shown how organisations engaged around agrobiodiversity issues may carry out scientific research, contributing to significant advancements in thinking and practices; how farmers involved in participatory plant breeding may acquire mastery of the matter and become autonomous in experimenting, and be recognised in this role; and how scientists committed to participatory action-research may learn together with other "practitioners-researchers", putting their expertise into play in the empirical arena to produce "knowledge in action and not simply knowledge for action" [8] (p.11). Of course, the implementation of an integrative, inclusive and democratic approach to knowledge creation is not a novelty [85]. The analysis, too, highlighting the importance of the quality of the relational context, has considered it as a key factor for the success of co-generation of new knowledge. What seems even more promising here is the empowering and evolutionary potential of mutual learning. The actors' role in knowledge creating may evolve, making the division of roles less sharp and giving rise to new potentialities [31].

Looking at the significance of a closer integration in knowledge creation, the analysis 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 stressed along the paper, it is a fundamental component of the development of collective agency. Once more, this alignment may stem from collaborative learning. Co-learning and shared reflexivity may lead to normatively involve all the actors, contributing to the development of coherent attitudes and actions and, as a whole, to the effectiveness of the innovation processes. A lack of this alignment may weaken these processes; its management and valorisation over time are equally important. Facilitation actions, working also on social and cultural dynamics, play a key role in taking care of these aspects.

Concerning facilitation, the analysis provides interesting insights to refine the effectiveness of this function in enabling adoption of more sustainable practices, as those aimed at enhancing agrobiodiversity, within agroecology. The complexity of change in farming/food practices has shown the importance of proper actions of facilitation, able to intervene in multiple, interconnected areas—not

just technical, but also institutional, legal, social and cultural domains. In turn, these may concern local socio-ecological systems as well as wider scales of action. This view of facilitation is in line with the acknowledgement of the broader concepts of innovation brokerage or systemic facilitation [34–36]. The analysis has shown that this kind of facilitation may be played by new actors, directly involved in the initiatives and coming from civil society, 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 the evidence, the system of creation of new knowledge appears to have become much more complex, including a variety of mutually interacting actors. In this context, identifying a single figure facilitating knowledge creation seems inappropriate, as multiple actors have started performing this function, hand in hand with the increasing integration of their respective role around common goals. This confirms the importance of adopting a different perspective, looking at a distributed, sometimes collectively managed facilitation function rather than at the role played by a specific category [34–36]. The evidences, however, show the challenges that this perspective poses when alignment around visions and interests weakens and divergences arise, because of the development of different agendas. Multi-facilitation needs a degree of coherence and coordination. How can this be achieved and maintained? Once more, mutual learning and the factors affecting it seem provide a key. On the basis of the study, a rigorous implementation of environmental justice principles could allow an early dialogue between possible, legitimately different perspectives and provide room, through mutual learning, to converge on shared frames, able to guarantee a certain degree of alignment and coherence. A continuative interaction is then crucial to assure a redefinition of shared positions to face unforeseen circumstances or trends. More in general, however, there remains the need for all facilitators to understand the importance of and converge towards a higher perspective of “common interest”. In fields such as those addressed here, increase of agrobiodiversity and agroecological transition, seeking coherence of individual, legitimate perspectives with a normative perspective recognised as higher is essential.

All this requires adopting a more advanced approach to these processes, and consequently thinking of innovative policy measures to support them. Even prior to that, additional research is needed to understand these processes deeply. The analysis presented in this paper is certainly not exhaustive, also because of the limitations of the study due to its size; however, it aimed to contribute to the discussion on a theme considered central in times of needed transition to sustainability. There is a need for more extensive and focused studies, aimed at investigating more deeply the potential of social learning in the co-evolutionary dynamics that characterise social-ecological systems, and the ways to exploit it fully.

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