

Article

Participatory Research towards Food System Redesign: Italian Case Study and Perspectives

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Abstract: Industrial agriculture and its requirement for standardized approaches is driving the world towards a global food system, shrinking the role of farmers and shifting decision-making power. On the contrary, a holistic perspective towards a new food-system design could meet the needs of a larger share of stakeholders. Long-term experiments are crucial in this transition, being the hub of knowledge and the workshop of ‘participation in’ and ‘appropriation of’ the research in agriculture over a long term. We present a methodology applied during the creation of a small network of organic farmers in Italy and detail the steps of the co-innovation process implemented. After a context analysis of the area to define the type of research and degree of participation, three steps were performed: (1) Identification of stakeholders; (2) dialogic identification of common activities; and (3) validation and feedback from participants. In the first participatory step, five organic farms were engaged for the second and third steps. We organized meetings to discuss future plans, facilitating the interaction process between farmers and researchers. These activities led to: (i) the definition of a research protocol based on farmers’ research needs for a new long-term experiment; (ii) committing farmers to take an active role in the research; and (iii) hosting experimental satellite trials in their own farms.

Keywords: agroecology; co-innovation; long-term experiment; innovation in agriculture; organic farming systems; stone-fruit

1. Introduction

FAO [1] reports “Sustainably improving agricultural productivity to meet increasing demand” as the first challenge of agriculture. Demand for food and products is indeed expected to increase by 50% between 2012 and 2050. On the other hand, it is well acknowledged how the modern and present food system has negative impacts (i.e., negative externalities) on public health and on the environment (e.g., pollutions and related human diseases), as well as on rural poverty and on power imbalances in globalised food chains [2]. With the modernization of agriculture, farmers, especially smallholders, are losing their central role in the food system, being reduced to simply implementing “recipes” [3], with consequences on decision-making power and opportunities. The challenge is hence transformed into a

need for urgent reform, moving away from the globally standardized and business-oriented approach of the current agriculture, toward a process of redesigning food systems in order to achieve ecological, economic, and social sustainability [4]. This objective can be faced by rethinking the agricultural stakeholders' role through their more consistent engagement in this redesign perspective: This would more genuinely engage the movement component of agroecology [5]. In this context, agroecology, as a scientific discipline, agricultural practice, and political or social movement, can meet the needs of the stakeholders and drive an effective change of the food system from the local to the global scale, considering the social, cultural, and ethical dimensions of agriculture [5]. Moving towards an agroecological farming system can lead to a restoration of the decision-making role of farmers in the food system, encouraging their direct involvement in the research, enriching it with their knowledge and experience [3,6]. Farmer-oriented, integrative, and participatory approaches to research could enable the preservation or increase of food system productivity in terms of yield, ecosystem services, and welfare [7], promoting dynamic innovation processes [8].

The integration of agroecological principles into the organic research agenda is a promising way to redesign farming systems towards a sustainable agriculture, encouraging participation of farmers with different production scales, perspectives, and outlooks [9,10].

Organic farmers, particularly small-holders, are open to exchange opinions and solutions in participatory activities aimed at: (i) Meeting the growing demand for local products and (ii) getting an appropriate price for their products, taking into account production costs and ensuring profit [11]. In this context, it is desirable to engage communities in projects with a "participatory" rather than "collaborative" approach, aiming to achieve useful targets for a broad community of farmers [12]. The idea behind this approach is that identifying and setting goals with the stakeholders is more effective than requiring their collaboration on imposed targets [13]. With this in mind, it becomes clear how long-term experiments could be crucial in implementing 'participation in' and 'appropriation of' the research over a long term [14]. Participatory action research (PAR) and its methodological approach can then be used to collaborate with local communities, to directly contribute to redirect current agrifood systems toward sustainability, responding to research questions of farmers and other actors of the territory, as well as guaranteeing greater autonomy and self-management [15–17]. In recent years, several studies investigated how to implement PAR at the local and European level as a tool to incentivize community-led local development strategies [3,17,18].

In this paper, we report the results of a participatory research experience carried out since 2015 between CREA—the Council for Agricultural Research and Agricultural Economics Analysis—and organic farmers interested and active in stone-fruit production operating in Lazio (a region in central Italy) (Figure 1). We identified a framework based on two lines of redesign: (i) From global to local, involving a change in governance; and (ii) from farm to territory; therefore, from the individual to the network. The presented work aimed at developing and activating a virtuous path of food-system redesign through the setup of an organic farmers' network, sharing objectives and perspectives on a local scale, and the joint proposal of solutions applicable at a territorial scale, tested simultaneously in the experimental farm of CREA and in the actual farms involved.

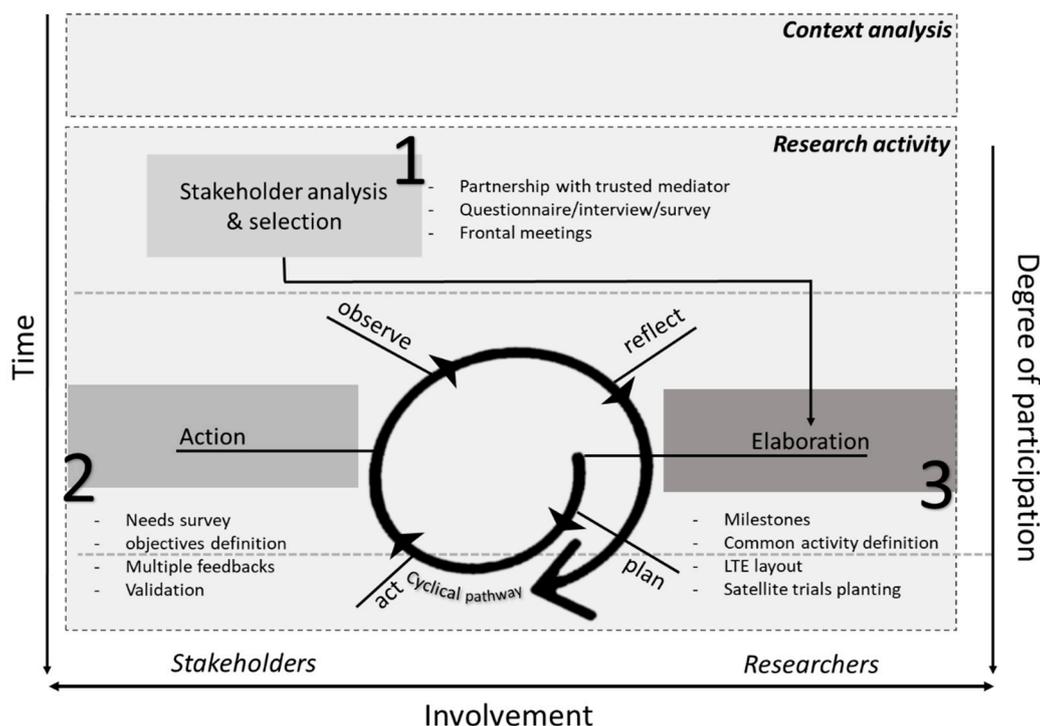


Figure 1. Logical framework of the methodology. After a context analysis, a three-step participatory approach was applied: (1) Identification of stakeholders' platform; (2) identification of milestones and common activities; and (3) validation and feedbacks on activities carried out. Note: The figure takes into account three dimensions: (1) Time: Linear, for what concerns context analysis, stakeholder analysis, and the first round of action and elaboration. Then, it spins into a circular feedback/adjustment pathway; (2) Degree of participation of stakeholder: None in the context analysis, as object of analysis in the stakeholder analysis and selection, as active subject in the action/elaboration back and forth; (3) Involvement: Step 2 (and further action steps) was stakeholder-led; step 3 (and further elaborations) was primarily researcher-based.

2. Materials and Methods

This paper presents the methodology developed for the creation of a small network of organic farmers in the Lazio Region (central Italy), and the steps of the co-innovation process that we implemented. Part of the research was also to reach a clearer understanding of the role, assets, and skills of researchers and farmers throughout the process [3,7,13]. The activities started in 2015 and are still ongoing. After a context analysis aimed at identifying the general aim and boundaries of the research, a three-step process was conceived: (i) Stakeholder analysis and selection (2015/2016); (ii) participatory definition of research objectives (2016); (iii) action–research activities establishment (2017–ongoing). The dynamic steps of our methodology are graphically outlined in Figure 1.

2.1. Context Analysis

As an entry point of the process (autumn 2015), CREA defined the type of research through a context analysis [13] to identify the main fruit productions of the area of interest (Lazio region), the role of researchers in the activity, and the expected degree of participation of stakeholders in the project. In particular, CREA was interested in setting up a new Long-Term Experiment (LTE) on fruit production aimed at facing the research priorities for local fruit farmers. On the basis of available statistics on the fruit production sector in Lazio, we defined the challenging issues in the region and evaluated the potential role of a public research institution (CREA) in the context. We determined the degree of local farmers' involvement in the formulation of the overall activity goals and in specific research topics for the LTE setup as main outputs of the system analysis step [7].

2.2. Step 1: Stakeholder Analysis and Selection

Since reciprocal trust is a prerequisite for participatory action research, a local association of farmers was chosen to assist in the identification of stakeholders. The Italian Association of Organic Farming (AIAB), Lazio section, provided a list of farmers for a preselection of stakeholders, based on their willingness to interact with a research institution and to realize joint activities. The identification of the target farms was performed according to the “Participation in information giving” strategy [19] (p. 14). With the help of the farmers’ association acting as cultural brokers (i.e., the person who facilitates the linkage among groups of people of different cultural backgrounds [20]), a questionnaire was submitted to potential stakeholders in direct telephone interviews (telephone survey [21]). The questionnaire was conceived by CREA researchers, based on a previous experience carried out in Italy [8], and it aimed to define: (i) Farmers’ perception of participatory research, (ii) main research demands for fruit production in the region, and (iii) the best way to facilitate farmers’ engagement in joint research activities. The questionnaire consisted of 20 questions, including four open-ended and 16 closed-ended questions. Among the latter, one question had two options. The other four questions were nominal-polytomous questions, with two unordered options and an open section in which it was asked to justify the previous choice. The remaining questions were simply nominal-polytomous questions [22]. The first four questions were designed to “warm up” and classify the respondents [8]. Question five was used to classify farmers into three groups: Farmers previously involved in participatory research with research institutions, farmers with independent research experiences in their own farm, and farmers with no research experience at all. It was a typical “skip” question, so the respondents who had experienced participatory research proceeded through the entire questionnaire [23], whereas the others were directed to question 11 (self-experience) or 13 (no previous experience). Questions 6–10, 11, and 12 were used to describe the type of research that was carried out. Questions 13 and 14 were set up on the basis of previous steps (system analysis) and used to identify and classify research topics for each respondent. Question 16 was a direct question about the respondent’s interest in studying the selected research topics in his own farm. The remaining questions aimed to catch the perception on participatory research and the willingness to join participatory activities. Question 20 was very broad, aiming to capture individual visions about participatory research: For this reason, it was set up as a “full open-ended” question [22]. Questionnaires were administrated in March 2016 and results were analysed in April 2016 in order to gain main information and a collective point of view. Qualitative responses were sorted by topic before data entry [8]. Data were analysed through ExcelTM, and results were condensed into figures based on the order of questions.

2.3. Step 2 and 3: Action–Research in a Circular Feedback

In the second part of the research, steps 2 and 3, we followed a modified “Participation by consultation” approach [19] (p. 14). We organized meetings with selected farmers to discuss activities to be carried out, and we facilitated and supported interactions between farmers and researchers. In particular, we applied an active listening approach, a communication technique in which the researcher verifies with the farmer to ensure a correct and accurate understanding [24]. During these meetings, researchers and farmers completed the following actions as a joint effort: (i) Selecting the research topics to be tested, (ii) outlining the “floating” network of farms, and (iii) defining the experimental layouts of the CREA LTE and satellite experiments in the other farms of the network. Steps 2 and 3 are conceptually separated, but they were carried out at the same time: One is a process aimed at gaining information and different points of view and it is wholly participatory; the second is a process of research elaboration of the collected information. Because in the latter process, the researcher works alone, feedback and new information from stakeholders are needed throughout (therefore, the circular approach). We therefore structured the process in an introductory context analysis and three-step process methodology with a work-in-progress number of milestones. The activities were then managed according to a long-range, cyclical, self-correcting mechanism, following a simple four-step model (plan, act, observe, reflect; the Action Research Spiral [25]) for maintaining

and enhancing the effectiveness of the results through self-analysis and self-renewal [26,27]. In this way, meetings were cyclically organized at the networks' farms, where findings and problems were discussed and analysed together.

3. Results and Discussion

3.1. Context Analysis and Researchers' Priorities

The context analysis phase allowed us to establish a list of priorities for our research. Results highlighted a growing consumer demand for organic fruits, not matched by a proportional increase of organic fruit production in terms of cropped area and number of farms [28,29]. Furthermore, the consumption of organic products in Italian school canteens is required by law (law 488/1999, item 59), and it is an important market opportunity for local organic productions. Statistical analysis of organic fruit production in Lazio is reported in Table 1.

Table 1. Statistical analysis of organic fruit production in Lazio region (2014).

	Consumption ¹ (Mg year ⁻¹)	UAA ² (ha)	Production ³ (Mg year ⁻¹)	Δ ⁴ (%)
Pome fruits	3406	39	458	13.4
Citrus fruits	2820	5	55	0.2
Stone fruits	2320	129	682	29.4
Kiwifruits	294	1514	6647	2260
Berries	232	21	95	40.9
Nuts	N/A	5562	4455	N/A

¹ Italian agri-food market institute (ISMEA) communication [28]. ² Utilized Agricultural Area [29]. ³ Data were estimated by using data from Italian National Institute of Statistics (ISTAT) [30] and National Information System on Organic Farming (SINAB) [29]. ⁴ Weight of local production on total consumption. Import and export are not considered in this estimation.

The chart compares consumption and production by Utilized Agricultural Area (UAA) and shows that these two factors are not directly proportional when the analysis is restricted to Lazio. Results highlighted contrasting trends for berries, stone, and pome fruits (40.9%, 29.4%, and 13.4% of Lazio productions, respectively). Only 0.2% of organic citrus fruit consumption was satisfied by local production, while kiwi fruit production was 2260% higher than internal consumption [28–30]. Furthermore, it is important to consider that pome fruit consumption is far higher than production and it is covered by internal national trade, while kiwi production is more than 20 times its consumption, as this crop is primarily geared towards export. Because one of our major goals was to redesign the system in order to shift power from global to local, we deemed stone fruits to be the most interesting and challenging sector. According to available literature, the main limitations to the diffusion of stone fruit organic cultivation are related to the challenges in pest and disease control without the use of chemical pesticide [31,32]. As a matter of fact, modern available cultivars of stone fruits (i.e., peach, apricot, cherry, and plum) were commonly selected for conventional systems, despite the strength of some breeding programs for resistance to biotic stress [33,34], highlighting the interest in carrying out research activities on this broad topic. It was therefore decided that a new orchard would be planted in the MAIOR-LTE (Maintenance of Organic Orchards—Long Term Experiment) at the Research Centre for Olive, Citrus, and Tree Fruit of CREA, located in Rome (latitude 41°47' N, 12°37' E). Farmers' involvement in all the following stages was promoted in order to achieve “the holistic perspective, share what works and what needs to be improved in the current system, set the evaluation criteria for innovations in accordance with their objectives, and test possible innovations” as van de Fliert and Braun [7] note. Through collaborative planning in defining problems and designing the research process, the final aim of this activity was to set up a real partnership among CREA researchers and farmers in long-term mutual learning and research activity [35].

3.2. Stakeholder Selection and Questionnaire Analysis

Once we defined the main fruit sector to be investigated, the selection of the stakeholders was carried out in partnership with the AIAB association, Lazio section. The focus was on organic farmers who already owned orchards and active stone fruit productions and who were potentially interested in collaborating with research institutions. Based on these criteria, AIAB selected 15 farms, covering the three main areas for stone fruit production in the Lazio region: (i) Hilly area in the North of Rome, (ii) Rome urban and peri urban area, and (iii) flat area in the South of Rome. Amongst these, six farms agreed to participate in the interview and complete the questionnaire. The main results of the questionnaire are reported in Figure 2.

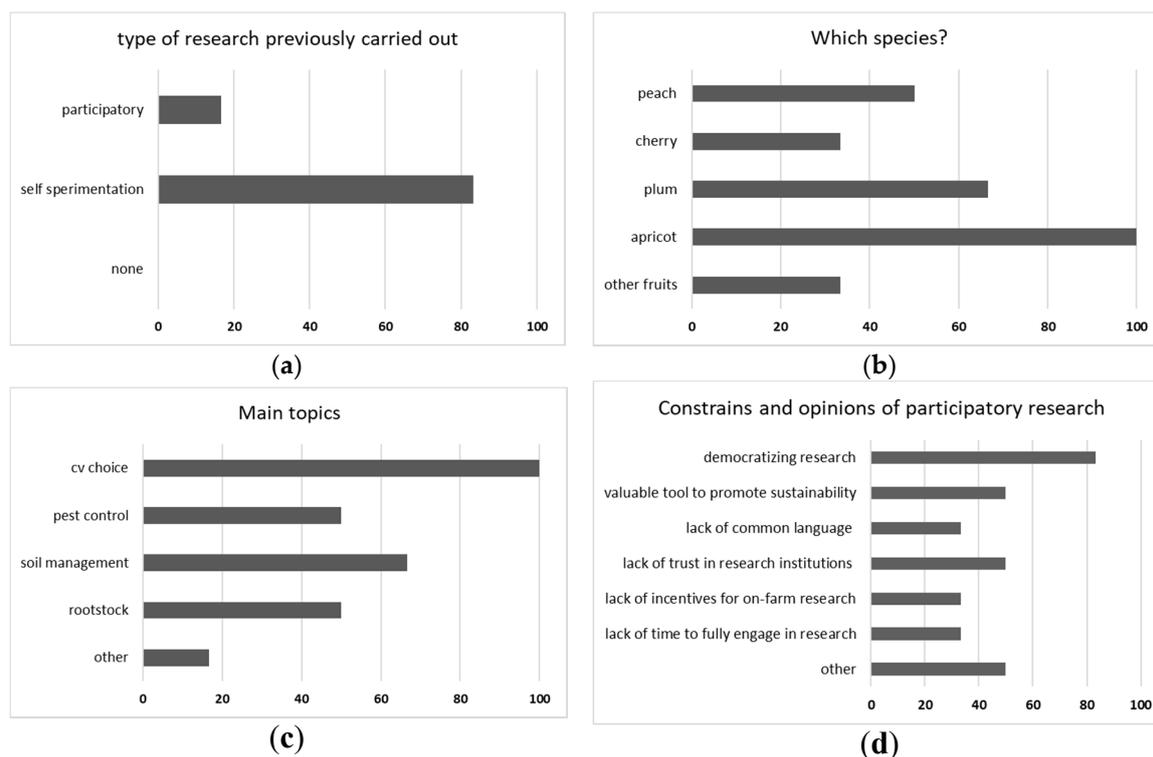


Figure 2. Main results derived from the questionnaires (six participants) on: (a) Previous research experiences; (b) species to be investigated; (c) main topics to be addressed; (d) constraints and opinions of participatory research. Values are reported as percentages of the total collected answers.

The preselected respondents confirmed their interest to join participatory experiences with CREA (100% of the respondents, data not showed), even if only one out of six was previously involved in similar activities (Figure 2a). Apricot was mentioned as the target species for the research activities of all the respondents (Figure 2b), with particular care to the identification of suitable cultivars for organic farming (100% of respondents), soil fertility management (66%), and pest control and rootstock choice (50%), as reported in Figure 2c. These topics emerged through active listening and in-depth interviews, thanks to the participatory nature of the research. All farms were small- to medium-scale, and the farmers marketed their production in the city of Rome. Because the Roman market is reduced during summer months, they highlighted a need for early varieties that were suitable for processing. In regards to the latter point, most of the farmers had already carried out self-experimentation on the cultivar topic (Figure 2c). Critical issues were the reduced production period of available varieties, low productions, and quality aspects. These results are in agreement with several authors' findings, recognizing the genotype issues as key aspects for sustainable organic research [36,37]. Questionnaire results about constraints and opinions of participatory research (Figure 2d) highlighted the lack of trust in research institutions as the main constraint (3 out of 6 respondents), confirming the expectations

and the hesitation found in the previous steps to get involved in participatory experiences, in contrast with previous findings [8]. Time, incentives, and common language between scientists and farmers emerged as other major concerns. The participatory research was defined as “democratizing research” (5 out of 6 respondents), and a “valuable tool to promote sustainability” at the environmental and economic level (3 out of 6) scored the highest rank, in agreement with previous findings [8].

3.3. Experiments Set-Up and Joint Activities

In May 2016, a meeting with farmers was organized at the Research Centre for Olive, Citrus, and Tree Fruits of CREA in Rome. During the meeting, the questionnaire results were shared amongst the participants and discussed together. In this first frontal meeting with farmers, apricot (*Prunus armeniaca* L.) was identified as a target species for experimental trials, whereas soil management and rootstock × variety/cultivar choices were recognized as main issues to be investigated at CREA MAIOR LTE. Moreover, five out of six farmers expressed their interest in hosting pilot experiments on their own farms, whereas the last one decided to limit the involvement to meeting participation. On this basis, an informal network (i.e., “apricot network”) of six farms (five pilot farms and one LTE) was set up, covering the three main areas for stone fruit production in Lazio: (i) Two farms in the hilly area in the North of Rome, (ii) two in Rome urban and peri urban area, and (iii) two in the flat area in the South of Rome (Figure 3).

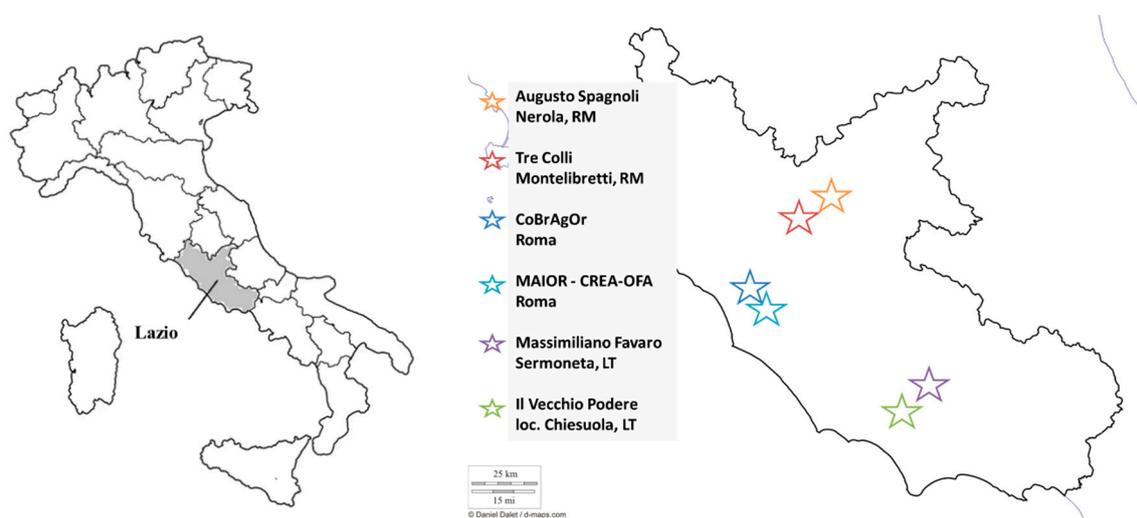


Figure 3. The “apricot network” set-up in Lazio region in Italy.

The overall objective of these activities was twofold: (i) Find the best combination of cultivars/rootstock/practices for organic apricot production in central Italy, co-testing the results with farmers in a “quality applied research”; (ii) address organic research toward Agroecology, contrasting the standardized and conventionalized input substitution approach in favour of a holistic and multidisciplinary one, in order to face the global challenges of the food system [9].

Together with farmers, ten apricot cultivars (chosen according to the following parameters: Early and medium-early ripening, modern and ancient cultivars, quality) and two rootstocks with different vigour were selected as promising for organic agriculture and for the Lazio market. The rootstocks selected for testing were Myrobalan 29C (clonal selection of *Prunus cerasifera*) and GF677 (*Prunus persica* (L.) Batsch × *Prunus amygdalus* (Mill.)) due to the potential contribution to tree vigour and production (the main interesting features highlighted by farmers). Myrobalan 29C is the most common rootstock used for apricot because of its compatibility with all cultivars and its adaptability to all kinds of soils [38], while GF677 was recently proposed for apricot to prevent suckers sprouting [39]. The choice of cultivars was partially directed from the questionnaire results, using suggestions and news on some genotypes supplied by growers. In general, we opted for early- and medium-ripening cultivar

to avoid Mediterranean fruit fly attacks, and for self-fertile ones to facilitate pollination (otherwise compatible cultivars were introduced). Low-chilling cultivars were avoided, and traditional varieties were introduced because of their supposed high rusticity [40,41]. San Castrese was used as a reference cultivar. Using the same criteria, eight different cultivars grafted on Myrabolan 29C were tested in four farms. The complete list of cultivars, rootstock combination, and their distribution among network farms is reported in Table 2.

Once the research topics were defined, the co-testing activities started with the MAIOR LTE designing and the pilot farm orchards planning. Parallel and open-ended investigations were scheduled in order to activate the action–research process by constant and critical observation. Findings were checked and discussed, and eventually, factors were changed [27,42]. The MAIOR LTE and the satellite farms were planted in subsequent moments (spring 2017 and spring 2018 for LTE and satellite farms, respectively), and meetings were arranged in order to transfer preliminary information from the experimental field in advance to pilot experiences. During these meetings, researchers illustrated and shared the research protocol, and farmers committed to following it in their experimental trials. The LTE orchard was designed to test two apricot cultivars, characterized by differences in vigour (i.e., Kioto and Pieve) within three soil management systems. These systems were designed to feature different levels of “agroecological intensification” [43]: (i) Business As Usual (BAU—common practices—soil tillage and use of commercial fertilizer); (ii) innovative diversified system with soil natural cover and compost use (INC—no soil tillage at transplanting, natural cover, Municipal Waste Compost, MWC), and (iii) innovative diversified system with introduced cover and compost use (ICC—introduction of Agroecological Service Crops, soil tillage, and MWC use). The MWC was supplied by the “AMA Roma Spa” company and obtained from the organic waste collected in the metropolitan area of Rome. The choice of this material as fertilizer was intended in the framework of the Circular Economy (EC, 2015), following the flow of the organic matter from the field to the society and closing the loop back to the field. The outcomes from the field activity (soil fertility, functional biodiversity, management costs, and feasibility at farm level) were then discussed with farmers and used as a base to plan farm orchard set-up and management. The ongoing participatory process will lead to the validation of the adequacy of the different apricot cultivars tested in MAIOR LTE and parallel trials to the organic method and the specific local conditions. At the same time, on the basis of the results of the MAIOR LTE trial, the most promising agricultural practices (e.g., flower strip introduction or MWC compost use) will be implemented in the parallel trials, promoting the innovation transfer from experimental to real conditions.

In summary, we have presented for the first time the application of a methodology for the establishment of a network of local farmers aimed at setting up long-term experiments that are representative of the local needs and research demands.

Table 2. List of cultivars, main characteristics, and distribution among network farms.

Cultivar (cv)	Characteristics			Rootstock	LTE	Co.Br.Ag.Or	Massimiliano Favaro	Il Vecchio Podere	Augusto Spagnoli	Tre Colli
	Ripening Date ¹	Self-Fertility	Type ²							
Ninfa	−24	X	M	Myrobalan 29C GF677						X X
Pinkot	−15		M	Myrobalan 29C GF677		X		X	X	X
Orange ruby	−10	X	M	Myrobalan 29C GF677						X X
Bella di Imola	−4	X	T	Myrobalan 29C GF677						X X
Mediabel	−4	X	M	Myrobalan 29C GF677						X X
Big Red	−4		M	Myrobalan 29C		X		X	X	X
Vitillo	−2	X	T	Myrobalan 29C GF677						X X
Kioto	0	X	M	Myrobalan 29C GF677	X X					X X
San Castrese	0	X	T	Myrobalan 29C GF677						X X
Flavorcot	+1	X	M	Myrobalan 29C GF677						X X
Ivonne Liverani	+1		T	Myrobalan 29C GF677		X		X	X	X
Pieve	+6	X	M	Myrobalan 29C GF677	X X	X		X	X	X
Portici	+7	X	T	Myrobalan 29C GF677						X X
Reale di Imola	+8	X	T	Myrobalan 29C GF 677						X X
Perla	+11	X	M	Myrobalan 29C		X		X	X	X
Dulcinea	+12	X	T	Myrobalan 29C		X		X	X	X
Palummella	+12	X	T	Myrobalan 29C		X		X	X	X

¹ Difference with respect to San Castrese (reference cv) ripening (25 June in Rome). ² M = modern cv; T = traditional cv.

4. Conclusions

This study demonstrates the validity of integrating farmers in the decisional role of applied research, identifying the lock-in and the barriers for the development of the organic production sector at the territorial scale. Through the activation of the action–research process, we demonstrated the feasibility of the co-definition of way-out strategies. To be effective, this process should be contextualized in the local sector, and the reciprocal trust with stakeholders should be promoted by sharing the aims, success criteria, framework, useable methodologies, mutual expectations, and rules of cooperation. Furthermore, it implies the need to define a common language, and this goal can be achieved through recurring meetings and workshop organizations. From an agronomic research perspective, our result found the participatory activities to be a valuable way to overcome temporal limits of project research in testing long-term factors, directly continuing in real farms the innovation path started in the experimental field (i.e., in our case, the evaluation of the fruit cultivars'/varieties' adequacy for organic management systems under local conditions).

Replicating similar experiences in other regions and/or production sectors can be an effective strategy to shift governance and move it to the territorial scale. Because the final aim is to replace the globalized food system with more sustainable and local ones, the implementation of this methodology can facilitate communication among groups, as it should be applied from the very beginning of the network creation. Moreover, local policy maker involvement in the local networks can be a success strategy in governing the transition from regional to wider contexts and it should be promoted in further initiatives.

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