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Levers and Obstacles of Effective Research and Innovation for Organic Food and Farming in Italy

Stefano Canali ^{1,2}, Daniele Antichi ^{2,3} , Simona Cristiano ⁴ , Mariangela Diacono ^{2,5,*} ,
Valentina Ferrante ^{6,7} , Paola Migliorini ^{8,9} , Francesco Riva ¹⁰, Alessandra Trincherà ^{1,2} ,
Raffaele Zanolì ^{11,12}  and Luca Colombo ^{2,13}

¹ Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment (CREA-AA), Via della Navicella 2-4, 00184 Roma, Italy; stefano.canali@crea.gov.it (S.C.); alessandra.trincherà@crea.gov.it (A.T.)

² Italian Research Network for Organic Research (RIRAB), 00159 Roma, Italy; daniele.antichi@unipi.it (D.A.); l.colombo@firab.it (L.C.)

³ Department of Agriculture, Food and Environment, University of Pisa, Via del Borghetto 80, 56124 Pisa, Italy

⁴ Council for Agricultural Research and Economics, Research Centre for Policy and Bioeconomy (CREA-PB), Via Po 14, 00198 Roma, Italy; simona.cristiano@crea.gov.it

⁵ Council for Agricultural Research and Economics, Research Centre for Agriculture and Environment (CREA-AA), Via Celso Ulpiani 5, 70125 Bari, Italy

⁶ Department of Environmental Science and Policy (ESP), Università degli Studi di Milano, Via G. Celoria 10, 20133 Milan, Italy; valentina.ferrante@unimi.it

⁷ Italian Association for Organic and Biodynamic Animal Production (Zoo.Bio.Di.), 20133 Milano, Italy

⁸ Department of Agriculture, University of Gastronomic Sciences, Piazza Vittorio Emanuele, 9, Bra (CN), 12060 Pollenzo, Italy; p.migliorini@unisg.it

⁹ European Association for Agroecology (Agroecology Europe), Rue Crotière 36, B-7530 Gaurain-Ramecroix, Belgium

¹⁰ Council for Agricultural Research and Economics, Central Administration, Project Research Management Office (CREA-AC), Via Po 14, 00198 Roma, Italy; francesco.riva@crea.gov.it

¹¹ Department of Agricultural, Food and Environmental Sciences (D3A), Università Politecnica delle Marche, Via Brecce Bianche, 60131 Ancona, Italy; zanolì@agrecon.univpm.it

¹² Italian Research Association on Organic Farming (GRAB-IT), 00159 Ancona, Italy

¹³ Italian Foundation for Research in Organic and Biodynamic Agriculture (FIRAB), Via Pio Molajoni 76, 00159 Rome, Italy

* Correspondence: mariangela.diacono@crea.gov.it; Tel.: +39-080-5475052

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Abstract: The objectives of this paper are to present the dynamic of organic food and farming (OFF) research and innovation, to outline challenges in deploying programs and accessing funding, and to define key actions to foster the development of tailored quality research on organic farming in Italy. The baseline starts from the main outcomes that emerged during the World Café held in the frame of the *Salone Internazionale del biologico e del naturale* (SANA Expo) in 2018, where the Italian OFF research community met to build a convergence on scope and modus operandi in the research endeavor. These outcomes were examined in the light of the key features of the research and innovation projects funded in Italy in the last 10 years, respectively by the Italian Ministry of Agriculture and the regional administrations through the innovation support instruments in the Rural Development Plan programming periods. In the period 2009–2018, 70 research projects for a total funding of 21.081 million € (<0.1% of the value of the sector) were launched, addressing nine different topic areas. Over a similar period (2007–2019), 53 regional innovation projects addressing organic farming were activated for a total budget of 14.299 million € (<10% of the entire available funding). The implementation of interventions in the research and the innovation areas were often scattered in terms of the topics, disciplines, and types of supply chain/network addressed. The relatively high share of multi/interdisciplinary research and innovation projects as

well as the acknowledgement of the multi-actor approach as a fundamental step toward co-research and co-innovation were upshots that emerged from our analysis. The outcomes of this study can be used by competent national and the regional authorities to design their future research and innovation policies and interventions.

Keywords: agroecology; European Innovation Partnership; multi-actor research projects; participatory research; Operational Groups; World Café

1. Introduction

1.1. A Snapshot of Organic Food and Farming in Italy

Over the last three decades, organic food and farming have continued to grow yearly across Europe [1]. Based on this attainment, the organic movement has been working towards an integrated vision that envisages 50% of Europe's agricultural land being managed, by 2030, according to the organic principles of health, ecology, fairness, and care [2].

The first pioneering experiences carried out in organic agriculture in Italy date back to the 1960s with the flourishing of alternative movements, and were more firmly established in the 1970s, involving farmers and consumers looking for healthy foods and environmentally friendly farming practices. During the mid-eighties, the Commissione Nazionale "Cos'è Biologico" (National Commission "What is organic") was established with the contribution of organic farming representatives and consumers' associations, which set the first self-regulatory standards for organic farming. In 1988, the commission changed its name to AIAB (Italian Association for Organic Agriculture).

After the EC Regulation 1991/2092, Italy designated the Ministry of Agriculture (currently Mipaaf) as the National Competent Authority, with the role of organizing and implementing the organic certification system for consumer protection and promoting the organic food and farming (OFF) sector's growth and development in Italy.

In 1992, the Italian Federation of Organic and Biodynamic Agriculture (FIAO—Federazione Italiana Agricoltura Organica; this then turned in 2005 into FEDERBIO—Federazione italiana agricoltura biologica e biodinamica) was founded, and in 2000, Mipaaf established the National Information System for Organic Farming (Sistema Informativo Nazionale per l'Agricoltura Biologica, SINAB). SINAB (www.sinab.it) is an open-source web platform offering information and services to stakeholders for the development and promotion of the organic sector. Nowadays, with 79,046 organic farms and close to 2 million hectares, Italy is in the 2018 top 10 of the list of countries with the largest number of organic producers and acreage [3].

1.2. Funding and Orienting Italian Organic Food and Farming Research

Since the early 1990s, Mipaaf had a major role in planning and funding national research for organic food and farming (OFF). In accordance with the requests of operators and taking into account the scientific, technical, and regulatory knowledge gaps, the first projects funded between 1994 and 2000 were mainly focused on research on soil fertility management and plant protection strategies, based on the use of allowed off-farm inputs, being therefore rather far from the systemic approach as it is nowadays conceived. In 2005, based on the "European action plan for organic food and farming" adopted by the EU Commission on June 10th, 2004, and approved by the EU Parliament on 10 March 2005, the first "National action programme for organic agriculture and products" was approved. Within this research framework, a number of projects were launched until 2009. As a 2005 National plan follow up, the Mipaaf Decree 13641/2009 identified four strategic axes and 14 key actions to support research and institutional empowerment actions for the following years. To update the strategy and make it more consistent with the OFF sector's requests raised in the course of the EXPO

2015–Feeding the planet, energy for the future context, on March 2016 the Italian State-Regions Conference approved the “National Strategic Plan for organic agriculture” [4]. The plan was the result of activity carried out by the Mipaaf along with all the sector’s stakeholders and included a set of 10 actions which would aid the transition from “Organic 2.0” to “Organic 3.0” [5]. In particular, the National Strategic Plan’s action nr.10 outlined the program for research and innovation in organic farming, whose design involved representatives of the organic sector, local authorities (i.e., regions), and public and private research institutions. This research program provided the institutional framework to finance the research actions and has been progressively implemented.

National and transnational (i.e., ERA-NETs) research actions, promoted in the framework of the above-mentioned programs, were financed through the revenues obtained from a specific tax of 2% over synthetic fertilizers and pesticides sales, introduced with the national law 488/1999 (and further modifications). The Mipaaf was appointed as the managing authority of the funds obtained from the tax, which is mainly addressed to funding research in organic farming. However, at present the Italian Parliament is discussing a proposal to modify the law 488/1999 (Bill 988/2018), aiming to use the tax for promoting and sustaining a wide set of activities in the area of organic food and farming, with the consequent risk of diluting and restraining resources for targeted research.

At different institutional levels, since 2007 Italy has been also devoting a relevant increasing amount of resources to collaborative innovation projects co-funded by the Rural Development Programmes (RDPs), managed by regional administrations. In fact, during the programming period 2003–2017, some 178.6 million euros have been invested in the specific “measure 124” (cooperation for the development of new products, processes, and technologies in the agriculture and food sector and in the forestry sector) of the RDPs, including also the organic farming sector [6]. Conversely, in the current programming period (2014–2020), the regional administrations allocated an overall budget of some 219 million euros to implement the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) by supporting the activation of Operational Groups (OGs) [7]. Based on the multi-actor principle, the EIP-AGRI brings together farmers, advisors, researchers, agribusinesses, NGOs and other relevant actors to co-generate agricultural and forestry innovations through targeting the specific needs/opportunities of farmers and agricultural systems. This multi-actor approach reflects the indications of the EU Standing Committee on Agricultural Research (SCAR) report on the Agricultural Knowledge and Innovation Systems (AKIS), which emphasizes the interactive model and trans-disciplinary nature of the innovation processes [8]. From the AKIS perspective, the actor is, at the same time, the co-provider of knowledge and the co-creator and end-user of the innovative solutions. As of the end of 2019, 442 OGs have been activated in the 12 regions and the Autonomous Province of Trento, who have fully implemented the RDP measure (authors’ elaboration based on Ascione and Ugati [7]). With this picture in mind, the main objectives of this paper are: (i) to present the dynamic of OFF research and innovation in the last 10 years; (ii) to assess the consistency between the vision of the Italian scientific community involved in research and innovation for OFF and the fundamental properties of the implemented research and innovation programs and projects; and (iii) to define key actions to foster the development of tailored quality research for OFF in Italy.

The baseline starts from the summary of the main outcomes expressed by the Italian research community, who met at the World Café held in Bologna in September 2018, afterward examined in the light of the features of the research and innovation projects funded in Italy since 2009. We also aimed to verify to what extent the implemented research and innovation trajectories are consistent with the current vision of the Italian organic research community. Moreover, the paper aims at delineating the characteristics and the pivotal properties of research and innovation actions that deserve to be maintained and/or further valorized, as well as at outlining the elements that in future planning need to be dropped, redesigned, and/or retuned to improve the quality of the research and innovation activities. We are, in fact, convinced that substantially improving research and innovation governance and impact to significantly support the OFF sector would contribute to tackling important challenges

that our society is facing in domains such as environment, climate, health and nutrition, employment, and social cohesion [9].

2. Materials and Methods

2.1. Outlining the Vision of the Italian Community Involved in OFF Research and Innovation: The World Café

In the frame of the *Salone Internazionale del biologico e del naturale* (SANA Expo) held in Bologna (Italy) on September 2018, a plenary World Café exercise was performed, with the objective to engage the Italian research community involved in organic food and farming (OFF) and agroecology (AE) in a common discussion. The objective was to identify and elaborate on the principles and the methodologies to be adopted for high-quality research on organic farming in Italy. The World Café also aimed to point out the main obstacles that, according to the participants' opinion, hamper knowledge building and dissemination in OFF and AE, as well as the challenges to be faced to enhance the research and innovation impact in Italy.

The workshop was promoted and organized by the three main scientific associations operating in the OFF sector in Italy (namely: *Gruppo di ricerca per l'agricoltura biologica-GrabIT*; *Rete italiana di ricerca per l'agricoltura biologica-RIRAB*; *Associazione Italiana di Zootecnia Biologica e Biodinamica-ZooBioDi*) and the European Association for Agroecology (*Agroecology Europe*), and involved Italian scientists as well as experts and practitioners committed to research and innovation development from universities and governmental and non-governmental research institutions.

The World Café format was adopted, as it is acknowledged to be a participatory structured process that attempts to promote collective conversations and discussions with a large number of participants, with everyone potentially talking at once [10]. Three different questions were launched by the World Café organizers, namely:

1. What principles should the research for organic farming and agroecology be inspired by?
2. What do you consider to be the three most important challenges/obstacles for the development of organic farming and agroecology research?
3. What are the methodologies to be used to achieve high-quality research in organic farming and agroecology?

The 33 Italian participants (Table S1) were divided into five "table groups" composed of 6–7 persons each, changing their composition after each question was given. In sequence, each participant presented herself/himself to the others, and a rapporteur was chosen within each group. After self-reflection (2 min), each participant reported her/his views to the other ones; an open conversation followed. Then, the rapporteur summarized the outcomes of the discussion, which were presented in plenary. The key issues and commonly proposed actions were then wrapped up at the end of the World Café and used to identify the relevant features of the research and innovation actions to be considered in our analysis and to nurture the results section of this paper.

2.2. Analysis of Italian Decade-Long Research Projects

In order to outline the main features of the research experiences implemented in Italy in the last 10 years, we performed a survey gathering the relevant properties of the research projects run from 2009 to 2018. In this survey, we considered the national and transnational research activities financed by Mipaaf through the revenues obtained from the above mentioned law 488/1999. For this reason, we also included research activities carried out by Italian research units operating in the frame of the "Coordination of European Transnational Research in Organic Food and Farming Systems" projects (Core Organic-ERA-NET action). Conversely, the research projects resulting from the last national call for projects [11] and appointed as eligible for funding in 2019 [12] were not included in our analysis, since those projects had not yet started at the end of 2019 (the closing time for the paper analysis). Data were obtained from the research section of the National (Italian) Information System for OFF

(SINAB; www.sinab.it) and integrated for clarification (when necessary) by interviewing the research officers and scientists directly involved in the projects. In detail, for each project, we collected the following properties that we considered relevant to describe and classify them:

The total funding (in Euro) and the assignment criteria, considering the two different implemented options—namely, (i) by a competitive process based on public calls, or (ii) by direct assignment to one of the Mipaaf supervised public research institutions.

The topic: nine main topic groups have been previously defined, and each project was univocally classified as one of them, based on the core research questions and considered hypotheses. These main topics were: (i) livestock production; (ii) arable crops and cropping systems; (iii) vegetable crops and cropping systems; (iv) fruit crops and cropping systems; (v) food quality and processing; (vi) socio-economic assessment; (vii) organic inputs (including seeds, fertilizers, plant protection products, and additives); (viii) agroforestry and mixed farming systems. In the last group, (ix) other, all the projects not included in the previous ones were listed.

The scale of intervention: we defined five classes: (i) laboratory scale, where most of the project activities were carried out in a confined environment and were aimed at studying specific basic bio-physical processes; (ii) field and cropping systems, including research projects aimed at studying agronomic processes and/or technical operations in field experiments, which are implemented either in research stations or in commercial farms/real conditions; (iii) farm scale, which encompasses research projects combining multiple aspects of farming (i.e., technical and economic aspects) and/or where data source and research outcomes were integrated across different activities characterizing the farming business (i.e., farm gate analysis); (iv) territory and value chain, which includes the research projects focused on questions relevant for areas being homogeneous from the physical, technical, social, and economic points of view—such projects included research aimed at describing and assessing the upstream and downstream of the farming activity [13]; (v) not applicable, including the research projects not classifiable in one of the previous scales of intervention.

The disciplinary dimension, in which we defined two classes: (i) monodisciplinary (the study of a research topic within one discipline) and (ii) pluri-disciplinary projects, including in this broad definition either multidisciplinary (the study of a research topic within one discipline, with support from other disciplines, bringing together multiple dimensions but always in the service of the driving discipline) and interdisciplinarity (the study of a research topic across multiple disciplines, and with the transfer of methods from one discipline to another. The research topic integrates different disciplinary approaches and methods) [14].

The Technology Readiness Level (TRL) of the research project [15], defining three classes grouping the levels as follows: (i) basic and applied research (TRL from 1 to 4); (ii) technology development and implementation (TRL 5–6); and (iii) system development and market scale (TRL 7–9). In addition, we defined a fourth group in order to classify the projects that were not classifiable within the TRL scale, like those regarding regulation development and implementation (iv).

The actors' involvement: great attention was also paid to this aspect, in both quantitative and qualitative terms, with the aim to evaluate if and how the “participatory approach” was applied. We refer here to the notion of actor provided in the 2012 EU SCAR report, as mentioned in the Introduction section (for more details, see [8]). Indeed, according to our overview, we have defined indicators which were considered relevant to this matter. Among them, the % of the total budget spent on funding activities directly addressed to promote the actor's involvement and/or directly carried out by them. Moreover, considering that actors are not eligible as project coordinators due to Italian funding rules, their positioning within the project consortia was monitored, ranking them as project partners or sub-contractors (thence, hierarchically and financially dependent from the funding partners of the project).

The actors' role: we introduced this feature to capture the quality of the actors' involvement. It considers the actors' active contribution, irrespectively by their formal role in the project partnership. The indicator was valued as “1” when the involvement was finalized only/mainly to implement the

dissemination activities, and “2” for those situations in which the actors had a pro-active/active role in the project design, results, and interpretation. If none of these circumstances was clearly identifiable and/or no rule was played by actors, this project feature was valued as “not applicable”.

2.3. Analysis of the Innovation Projects Co-Funded by the RDPs in Italy

In our analysis, collaborative innovation projects within the organic food sector have been searched for, in relation to the current (2014–2020) and previous (2007–2013) Rural Development programming periods, covering approximately 10 years of project activities. In particular, for the 2007–2013 Common Agriculture Policy (CAP) implementation period, a number of 872 innovation projects has been examined in relation to the so called “Cooperation and Innovation” RDP measure 124, which was implemented by almost all Italian managing authorities (19 regions over a total of 20).

Besides this, the ongoing 2014–2020 CAP implementation was surveyed, limited to the Operational Groups (OGs) already activated under Measure 16 (cooperation) of the RDPs, for which relevant data became available in December 2019. All in all, the analyses of this article refer to a number of 386 OGs funded by the managing authorities of 11 RDPs, including Basilicata, the autonomous provinces of Bolzano and Trento, Lombardia, Friuli Venezia Giulia, Veneto, Emilia Romagna, Toscana, Umbria, Marche, and Campania.

It should be considered that, until we started drafting this article, the level of implementation of Measure 16 was still in a substantial delay, considering that the programming period will end by 2020 and that the number of OGs by region and autonomous province is still increasing.

Data have been elaborated based on:

- (i) the National Rural Network repository (NRN; www.reterurale.it) for innovation projects;
- (ii) the lists of selected beneficiaries published by the different managing authorities;
- (iii) selected interviews to the latter to clarify specific details.

To allow us to detect proposals with a specific goal in the sector, the term “organic”, (“biologico”, in Italian) has been browsed in project titles and/or as a keyword in the project short description. In this sense, the term “organic project” states a project whose objective is the introduction of an innovation, directly and explicitly in organic farming, and not as a general reference.

Moreover, the participation of organic farms in innovative partnerships has been similarly searched for to analyze their role and propensity to innovation independently of the overall project goal. To identify the organic farmers participating in innovation projects, in our analysis the company files of the participants in the 124 (programming period 2007–2013) and 16 (current programming period) RDP measures have been crosschecked with the official list of organic operators of the SIAN (National Agricultural Information System; www.sian.it). Finally, their relative weight in the above-mentioned initiatives has been evaluated by considering the overall number of farms, farmers’ cooperatives, and associations involved in the innovation projects.

To scrutinize the possible continuity of the organic farmers’ participation in innovation-funded initiatives across the programming periods, whatever the nature of the projects, we have crosschecked their presence in both measures 124 and 16 in the respective NRN databases. This procedure allowed us to analyze the organic farmers’ interest in enduring efforts in publicly funded innovation.

3. Results and Discussion

3.1. The World Café Identified the Vision of the Italian Research Community

The objective of the World Café held in the frame of the SANA Expo was to identify and elaborate on the principles and methodologies to be adopted for high-quality research on organic farming in Italy. Therefore, the current vision expressed by the Italian research community on research and innovation trajectories is presented and examined in the light of the projects funded in Italy in the last 10 years. The objective was to outline the challenges in deploying programs and accessing funding,

pointing out the obstacles in knowledge building, and to define key actions to foster the development of quality research on organic farming in Italy. To this end, the properties of the research and innovation actions to be maintained and/or valorized are presented, outlining the elements that should be dropped, redesigned, and/or returned to improve the quality of the research and innovation activities.

The World Café participants primarily cited the “Principles of Organic Agriculture” of the International Federation of Organic Agriculture Movements (Table 1) as driving paramount principles to be implemented in any OFF activity domains, including research planning and design. Some of the participants mentioned the “principle of beauty” to be taken into account, in order to run operations characterized by their own appropriate harmony of aesthetic canons (i.e., the beauty of fields, farms, territories), but also attributing a wider and more conceptual meaning to the beauty, referable to goodness, truth, and justice [16].

Table 1. The 4 IFOAM principles of Organic Farming (Source: IFOAM [2]).

Principle	Description
Health	Organic agriculture should sustain and enhance the health of soil, plants, animals, and humans as one and indivisible.
Ecology	Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them, and help sustain them.
Fairness	Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
Care	Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Besides the basic principles, when dealing with research and innovation in organic farming, the attendees also mentioned specific additional values to be taken into account. It was stated that the organic agricultural knowledge and innovation system must be based on the participation of the relevant actors along with the whole knowledge chain being, consequently, all the activities of research and innovation (i.e., planning, projecting, implementation, and result evaluation) authentically shared from the origin. Participation was not uniquely and merely seen as a methodology to enhance the impact of research and innovation actions, but also a way forward to trigger a broader mobilization of agricultural research democratization. Similar considerations were proposed by Pimbert et al. [17] in their paper calling for a progressive, inclusive, and ethical research agenda for food and farming.

The respect of the role, the knowledge, and the expertise of the different actors (the ones who directly and actively participate in research and innovation actions, including academics and public and private researchers and practitioners) and stakeholders (all those who have rights, interests, or expectations, being thus able to influence the research and innovation program and project trajectories, even if not directly participating in performing actions) was also stressed. Wide participation and engagement could be obtained by applying different methodologies, such as on-farm research, promoting networking among researchers and actors, thus implementing citizen science approaches [18].

The principles of autonomy and impartiality were considered fundamental attributes of ethical practices for academics and researchers [19]. Yet, the open-source approach was acknowledged to be essential, and it was stated that this strategy should be widely adopted in all aspects of future research for organic farming, not merely limiting it to the area of technological and digital innovation. The exploitation of patents, copyright, licensing, domains, and other forms of intellectual property rights should be limited as much as possible and/or more wisely applied in the interest of the whole society. The policies to promote the intellectual property protection implemented by public research funding bodies, universities, and other public research institutions should be, in this light, deeply reconsidered to avoid the “patent or perish” phenomenon, as discussed by Twardowski [20].

The many challenges and/or obstacles mentioned by the participants to the World Café were considered as two sides of the same coin, being the challenges intended as the efforts to trigger-off the lock-ins removal. The lack of national funding of both public and/or private origin was identified as the main obstacle to implementing adequate organic research in terms of quantity and quality. In addition

to the implementation of an appropriate public research planning activity, to be promoted by national and local authorities, the development of effective policies to mobilize private funding in the organic agri-food sector should be prioritized.

Indeed, it was acknowledged that, at present, the policy instruments and the regulatory framework implemented in Italy are not always effective in promoting the public/private research partnership, with the red tape being a burden for research activity development. In particular, the way in which the state aid regulation is implemented in Italy [21] should likely be revised and updated in light of the most recent European legislation [22–24].

Yet, we observed that crowdfunding (i.e., the practice of funding a project or venture by raising small amounts of money from a large number of people) was in general not adequately explored and promoted for the rural sector [25]. This is applicable for Italy, too, where both governmental and private institutions missioned to the agri-food sector research and innovation are not familiar with the implementation of this funding strategy, which remains non-exploited or limitedly exploited for organic agriculture in the country.

According to the attendees' opinion, other obstacles were identified in the research programs' features, which were often too specific and/or not broad enough to encompass societal needs in research projects. It was also remarked that research is often planned and funded over short timescales and threatened by funding limitations and changes in stewardship [26]. In organic agricultural research, exploring the effect of innovative practices (e.g., agroecological practices aimed at improving organic farming sustainability) on slowly evolving parameters requires the support of activities/experiments over the long run [9]. This change in perspective could produce relevant results, strongly contributing to the agricultural system sustainability, such as the identification of climate change and mitigation strategies, as well as the long-term effects of contrasting management options on biodiversity and the related ecological services/disservices [27].

According to the World Café participants, the promotion of multi/interdisciplinary research was not adequately addressed by most of the national research programs, even if it was acknowledged that, in Italy (similarly to other European countries), the scientific community involved in organic food and farming research demonstrated greater aptitude to overcome disciplinary and specialization limits than the conventional scientific community [28]. On the other hand, the lack of interest in conducting research in the organic sector of the majority of Italian scientists was attributed to the way in which the research activity is rewarded. In fact, it was considered how the present schemes of evaluating and rewarding researcher careers based on bibliometric indexes and/or knowledge property protection elements push toward the "publish and patent or perish" system [20], thus encouraging conventional highly specialized, short-term research.

3.2. Overview of the Italian Research Projects for Organic Farming

Regarding the Italian research projects for organic farming, the participants of the World Café highlighted some key points: (i) the driving principles of OFF research are "Principles of Organic Agriculture" of the International Federation of Organic Agriculture Movements; (ii) the knowledge and innovation system in organic farming must be based on the participation (by on-farm research, networking with researchers, and citizen science approaches) of the relevant actors and stakeholders, respecting the role and the expertise of each of them; (iii) the open-source approach was acknowledged to be essential; (iv) the main obstacle to implementing adequate organic research was identified in the lack of national funding of both public and/or private origin; (v) research programs were considered not broad enough to encompass societal needs into research projects, which are often planned and funded over short timescales that cannot fit well with the assessment of innovative agro-ecological practices; (vi) multi/interdisciplinary research was considered not adequately addressed by most of the national research programs.

To support these outcomes, we assessed to what extent the funded projects were consistent with the vision expressed by the national organic research community in the World Café. In particular,

we referred to the issue of the lack of national funding of public and/or private origin, reporting in Table 2 the number of projects and funding by the main research topics. In the period 2009–2018, 70 research projects for a total funding of 21.081 million € were launched (an average of 2.342 M€/year). These figures show the low investment into research in the organic food and farming sectors in Italy; this, on average, was 0.094% of the cumulative value of the Italian organic food and farming market (internal consumption, excluding restaurants and public food procurement), which was estimated as 2.5 B€/year in 2018 [29]. It is worth considering that, in the period 2014–2017, the European gross domestic expenditure on research and innovation was 2.06% of the Gross Domestic Product (GDP), and that the European target is set in the Europe 2020 strategy as 3% of the GDP, whereas the less ambitious Italian target is 1.53%. [30,31]. Moreover, the funds devoted to research in OFF will likely further decrease if the bill 988/2018 is approved by the Italian Parliament. In fact, under this scenario, if the new law will be in force the revenues obtained from the tax on synthetic fertilizers and pesticides will not be used only to fund research (as it is now), but could be also utilized for other initiatives, such as campaigns to promote the consumption of organic products, to support market organization, or to improve the control system.

Table 2. Main research topic, number, and budget of the organic food and farming (OFF) research projects funded in Italy from 2009 to 2018.

Research Topic	Projects (n)	Total Funding (M€)
Organic inputs (seeds, fertilisers, PPPs ¹ , additives)	14	4.078
Livestock production	13	2.620
Food quality and processing	11	1.893
Vegetable crops and cropping systems	10	1.747
Other	8	3.169
Fruit crops and cropping systems	5	1.109
Socio-economic assessment	5	4.825
Arable crops and cropping systems	4	1.642
Total	70	21.081

¹ PPP = Plant Protection Products.

Among all, 58 projects (for a total funding of 18.038 M€, accounting for 86% of the total funding) were directly assigned to one of the Mipaaf supervised public research institutions (i.e., the Council for Agricultural Research and Economics, the institute for research studies and information on the agricultural market, and the national body for rice production) that was appointed as coordinator, only rarely involving other public and private research institutions or sector representatives as partners.

Fourteen projects out of 70 were funded to research addressing upstream in the value chain, in the area of organic “off-farm inputs” (i.e., plant protection products, fertilizers, soil conditioners, seeds, and additives), thus demonstrating that this was considered as a high priority topic in the last decade. In more details, the projects were related to the setup and management of input lists, to provide guidance to the competent authority regarding inputs eligibility and acceptability criteria or to contribute to the solution of specific issues, such as the origin of the phosphite contamination of organic food products, the reduction in the use of copper-based inputs and their acceptability in organic agriculture, as well as the rules of the utilization of other contentious inputs [32]. Similarly, the topic of “livestock production” included a high number of projects (13) which received relatively high funding (2.620 M€) for research projects in the area of organic poultry, cow milk, and fish production. Altogether, the three topics related to plant production (namely, vegetable, fruit, and arable crops and cropping systems) accounted for 19 projects and 4.498 K€, and were almost uniformly distributed among the three sectors.

Although 11 projects were included in the area of “food quality and processing”, this topic received a relatively low total funding. In fact, the budget was very low for each project, ranging from

a minimum of 40 K€ to a maximum of 297 K€. This evidence seems to indicate the scarce interest and/or the low priority in researching in the downstream of organic food systems in the last 10 years.

Moreover, 12 of the 13 projects included in the two topics of “socio-economic assessment” and “other” were aimed to provide the Italian authorities (i.e., the Ministry of Agriculture) with market analyses and technical and regulatory advice. These relatively large projects (591 K€/project, on average), which were directly assigned to the Mipaaf-supervised public research institutions, absorbed more than 7 M€ (almost the 30% of the total funding) over the last 10 years. They should be encompassed in the area of the institutional support actions and, even if acknowledged to be beneficial for the sector, could not be considered as research *strictu sensu*. These considerations further demonstrate the exiguity of the expenditures in research actions for the organic food and farming sector in Italy.

Finally, in order to delineate the areas of the research for the near future, in Table 3 the topics of the 2018 call and the number of research projects that have been appointed as eligible for funding are reported. As mentioned in Section 2.2., these projects were not included in the analysis because they were not yet implemented by December 2019 and information regarding their properties was not available.

Table 3. Research projects of the call 2018 (Mipaaf Decree 67374 of the 27th September 2018).

#	Topic Title	Eligible (n)	Not Eligible (n)
1	Diversified cropping systems for feed production	4	1
2	Machinery and novel technologies for soil tillage	1	0
3	Agri-Zoo-Forestry multifunctional and diversified production systems	5	1
4	Process and conservation technologies, adjuvants and additives for organic food products. Small scale transformation technologies for local products	2	4
		13	6

Notes: five additional projects were excluded due to lack of eligibility requirements or were not admitted to evaluation.

Figure 1 shows the number, the total, and the average funding of the organic farming research projects financed in Italy from 2009 and 2018 by intervention scale, irrespective of the topic in which they were classified (see Section 2.2). Most of the projects were pertinent to the “territory and value chain” scale, which included the larger projects (0.461 K€/project, on average), while the “farm” scale was underrepresented, encompassing only 10% of the projects and 7% of the total funding. Intermediate figures were shown by the “laboratory” and “field/cropping systems” scales.

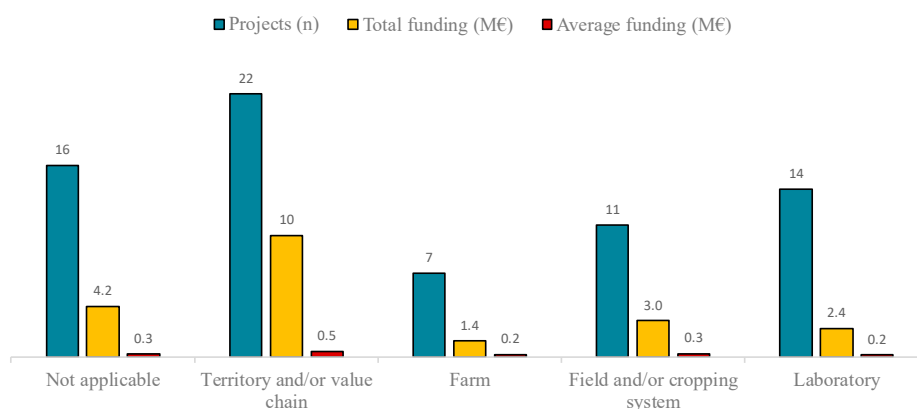


Figure 1. Number and total and average funding of the organic farming research projects financed in Italy from 2009 and 2018 by intervention scale.

These results showed a polarization of research investments towards the small- and the large-scale dimensions, indicating that, in the next research programs, corrections to rebalance the research intervention at the farm scale are opportune. Again, in the “not applicable” category we included all the institutional support action projects not uniquely attributable to a specific scale.

Considering the criterion of disciplinary dimension, multi and interdisciplinary projects resulted in being the majority, and most of the total funding (78.0%) was spent for the 37 multi and interdisciplinary projects; only a minor share (22.0%) was spent on the 33 remaining monodisciplinary or not classified ones. Moreover, we observed that the multi and interdisciplinary projects average budget (about 0.444 K€) was approximatively three times higher than that of the monodisciplinary ones (0.141 K€). These results are in line with expectations, as monodisciplinary research was generally considered as not suitable for a systemic approach and to face the knowledge questions addressed by organic actors and stakeholders and, therefore, was generally not encouraged by organic research programs. The most represented topics of the monodisciplinary group were (i) livestock productions and (ii) organic inputs. This could be explained considering that such projects were mainly funded to address crucial matters to support the implementation of the European regulations in organic food and farming that were approved across the analyzed period. In the case of livestock production, this result could also be interpreted considering that, in Italy, this research topic was mainly considered as a specialized field of study, not following a systemic approach aimed at integrating livestock and plant production and implementing the mixed farming model. Besides that, considering the Technology Readiness Level criterion, no projects encompassed in the TRL 7–9 stage (system development and market scale) were classified as monodisciplinary, confirming the need for the inter/multidisciplinary approach to tackle with system-oriented research [33].

Regarding the actor (see Section 3.1) involvement criterion, we found that actors were involved in only 23 research projects out of 70, indicating that participatory research was not appropriately promoted and implemented in Italy in the last decade. However, when involved, actors tended to play an active role in the project design, result achievements, and interpretation (71% of the cases), irrespective of their formal position in the consortium (i.e., subcontractors or partners). On the other hand, their formal role in the consortia strongly conditioned the share of project budget they received, being on average 15% and 32% when they were involved as subcontractors or partners, respectively.

3.3. Innovation Projects for the Organic Food and Farming Sector in Italy

The previous analysis showed that in Italy, over the tested 10-year period, very limited resources were spent for research and innovation in OFF. The relatively high share of multi/interdisciplinary projects and the recognition of the multi-actor approach as crucial in fostering co-research and co-innovation also clearly emerged. Data elaborated based on the National Rural Network repository applying the methodology described in Section 2.3 show that innovation in and for the organic sector receives constant and growing attention by operators. Moreover, since the very beginning of the current programming period, the organic farming system has so far been characterized by its capacity to stimulate, aggregate, and organize actors around the collaborative innovation paths foreseen for the innovative projects of Operational Groups (OGs) [34].

As a matter of fact, comparing projects across the present and previous RDP programming periods indicates a significant increase in initiatives in the monitored regions, escalating to 32 projects run by OGs from 21 in the 2007–2013 period. Significantly, this numerical growth should be projected to an even greater decalage by the end of the programming period, considering that the pertinent available information only relates to a mid-term situation. The share of organic OGs in the analyzed Italian regions anyway remains confined: even if increasing from 3% in the previous RDP period, only 8% of all OGs have been activated in (explicit) organic projects. This share means that about 9.3% of the funding is envisaged in the total number of activated OGs, and it is well below the proportion of organic acreage vis-à-vis the national agricultural used area (15.4% in 2017, 15.8% in 2018). The 32 organic OGs engage a total funding of 11.437 million €, accounting for an average of 247 K€ (some 32% below the average of OGs other than organic). Besides this, the total number of collaborative innovation projects (53) funded during the period 2007–2019 engages a total funding of 14.299 million € which, on average, is 0.057% of the cumulative value of the Italian organic food and farming market estimated for the year 2018 [29].

According to the interviews, a partial justification for this still limited share of OGs and investments can be empirically due to the political decision adopted by some regional administrations to consider organic as any other sectors, thus reserving a de facto maximum budget to such OGs. Similarly, a possible deficit in the representativeness of the organic sector in OGs may be explained by the recent surge in interest in agroecological or other low-external inputs approaches and frameworks that converge in scope with organic but shadow its explicit appearance.

A complementary interesting proxy of organic operators' eagerness to innovation is their participation in OGs, independently on their explicit goal and technical approach. Indeed, over 36% of all the farmers or farmers' cooperatives/associations/consortia involved in the selected OGs are listed in the SIAN as organic operators (elaboration does not cover all the selected OGs due to the lack of micro data on partners). This is a strikingly greater figure than the 4.5% of the Italian organic farm share [29], being 2.5% in 2008 at the eve of the past planning period when 32% of farms participating in the innovation projects were organic.

Moreover, the high frequency of organic farms in innovation projects in the last 10 years is complemented by the apparent continuity of several such farms (some over 15%) in innovation initiatives across the planning periods, showing a sort of endless hunger for novelty, whatever the nature and scope.

All in all, the analysis of the organic OGs partnerships highlights a good balance in the actors' multiplicity (eight partners per OG, on average) and this, very convincingly, reflects a good degree of the multi-actor approach implementation and the circulation of transdisciplinary knowledge within the innovative partnerships: 48% farmers and associative bodies; 42% academia and research; 15% specialized advisory services; 6% training and education centers; 4% biodistricts.

Taking into consideration more technical elements, such as the innovation topics, and using the same criteria adopted for the research projects funded by the Italian Ministry of Agriculture, the first prominent consideration is that the organic livestock sector receives very poor attention/funding (Figure 2).

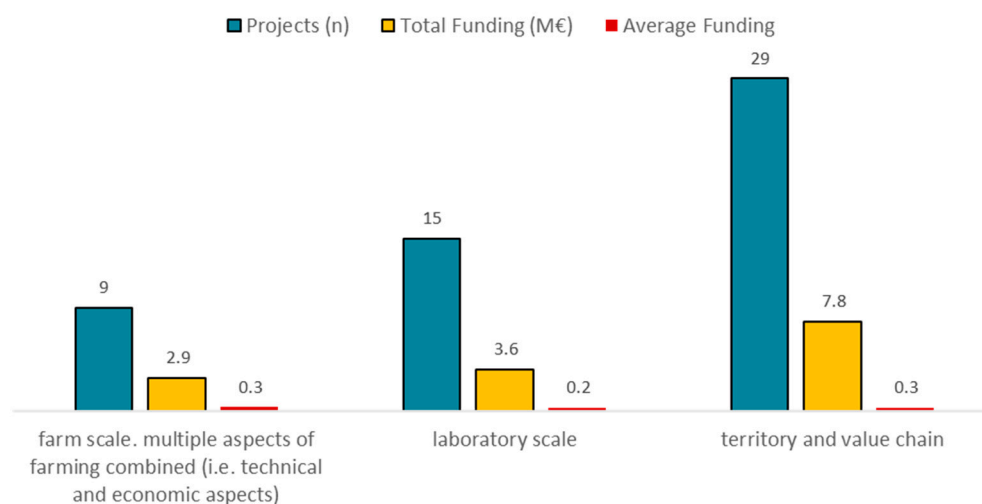


Figure 2. Number and total and average funding of the organic farming innovation projects financed in Italy from 2007 and 2019 by intervention scale.

Among the scrutinized projects in the selected regions, four projects were devoted to animals for a total funding of 824 K€ and the lowest average budget on projects (206 K€). Among them, only one regards the bigger-size livestock (e.g., sheep), and it is devoted to dairy products. Meanwhile, the other innovation projects cover food processing and packaging issues (e.g., poultry); the introduction of high performing quality standards to meliorate the production and genetic selection of rabbits in farms; and, ultimately, a device capable of enhancing the use of photovoltaic energy in the fight against varroa and limiting the use of synthetic acaricides in bees.

Plants are at the core of organic innovation, with a relatively fair distribution among the sub-sectors: arable and cereal crops (32% of the OG projects), viticulture (18%), horticulture (13%), and orchards (17%) confirm their economic relevance and leaning to innovation. Vice versa, more mature and less problematic sectors, such as olives or fibre, are partially neglected (Table 4).

Table 4. Main innovation topics and the number and budget of the OFF projects funded in Italy from 2007 to 2019.

Innovation Topic	Projects (n)	Total Funding (M€)
Arable crops and cropping systems	10	3.409
Organic inputs (seeds, fertilisers, PPPs, additives)	5	2.157
Other	8	2.155
Vegetable crops and cropping systems	8	2.050
Food quality and processing	10	2.000
Socio-economic assessment	4	855
Fruit crops and cropping systems	4	850
Livestock production	4	824
Total	53	14.299

In relation to the scale of intervention, the farm scale shows a relatively limited importance (20%) and is not dissimilar to that attributed to the lab scale—here, mostly intended as a processing stage—with 26% of the projects, while more than half (54%) are those addressing the territorial and value chains dynamics, probably in consideration to their closeness to the market. This is also confirmed by the relevance of food quality and socio-economic assessment projects that together represent 22% of the projects. Finally, organic inputs keep being seen as a crucial area for innovation, representing 15% of the funded projects.

Nevertheless, leaning to innovation cannot be fully monitored through these results, as they only reflect publicly funded projects: self- or privately funded initiatives are not observed and reported by this paper. Similarly, proposals rejected by the funding administrations are not surveyed by this study, it being impossible to predict the scale and breadth of the organic sector effort to mobilize financial resources in support of innovation endeavors. Moreover, interest in accessing RDP funding should not be taken as granted, since bureaucracy, delays in receiving payments, the lack of financial anticipation. As well as the impossibility of getting labor reimbursed for direct farmers with no employees represent important disincentives.

4. Overall Considerations, Conclusions, and Recommendations

The analysis of the research and innovation initiatives promoted in Italy in the last decade allowed us to assess to what extent the funded projects were consistent with the vision expressed by the national organic research community. The key features of the past interventions that need to be retuned and/or updated have been selected with the aim of identifying and removing lock-ins to a genuinely participatory and resourceful OFF research, thus adapting and improving the funding schemes. Our explicit ambition is to provide recommendations to the competent national and the regional authorities for designing future research and innovation policy and interventions.

Overall, our analysis showed that, over the 10 years of the addressed period, in Italy very limited resources were spent on research and innovation in OFF in relation to the sector dimensions and its vitality, dynamicity, and ability to foster knowledge and innovation as a lever to sustain the sector's growth. The relatively high share of multi/interdisciplinary research and innovation projects as well as the recognition of the OFF sector of the multi-actor approach as a fundamental step toward co-research and co-innovation were additional upshots that emerged from our work.

Moreover, we observed that the implementation of interventions in the research and the innovation areas were often scattered in terms of the topics, discipline, and type of supply chain/network addressed,

lacking a more integrated vision. as they would address specific needs as a patchwork rather than resulting from a more comprehensive planning for the OFF sector development as a whole. This particularly relates to the research activities whose topics are often defined top-down.

We also noticed that, although the topic “agroforestry and mixed farming systems” was mentioned as a priority in the Italian action plan for research and innovation in organic farming [4], no projects addressed the thematic. However, it is relevant to underline that the subsequent 2018 research call published by the Italian Ministry of Agriculture (Mipaaf Decree 67374 of the 27th September 2018) included the topic “agroforestry and mixed system”, with the aim of funding three small research projects, with a budget of 0.9 million € in total. Indeed, research efforts are needed to identify and analyze the levers that can favor the adoption of agroforestry in organic farming and the obstacles existing at the level of cropping system, farm, and agri-food chain [35]. This evidence should be considered for retuning the priorities of the next research and innovation programs.

As regards the innovation projects, they originate from operators’ proposals on contingent issues, not least at a very local scale. Yet, the EIP-AGRI implementation, as well as the previous innovation programming, was differently executed across the regions due to the diverse stage of implementation of the Rural Development Programme. This difference was sometimes linked with some directive and normative approaches that lead to innovation compliance more than creativity, thus contributing to preventing harmonic OFF growth at the national level. A weak functional linkage between the national research interventions and the regional innovation initiatives also emerges, as they are not operationally interconnected, hampering the concatenation of a harmonized knowledge creation/exploitation chain. A stronger coordination between the national central authorities appointed to research programs and funding in OFF (i.e., Mipaaf) and the regions that are responsible for the implementation of the RDP innovation strategy is advisable, in order to amplify the impact of better-connected research and innovation planning and activities.

In general, we can affirm that such institutions in Italy were only partially able to capture the impetus unleashed by the national OFF scientific and actor community. Indeed, the systemic approach concept, the co-research and co-innovation principles, as well as the multi- and inter-disciplinary dimension are still resulted poorly considered. We acknowledge that efforts have been made, but in order to align research and innovation programs and funding schemes to higher quality standards, both national and regional authorities should embark on a similarly courageous institutional innovation. The aim should be to open planning to more participatory processes to upgrade implementation rules and procedures and to minimize the bureaucratic burden.

Overall, on the basis of our considerations and conclusions, we also intend to propose our recommendations, outlining the following seven key points:

1. A fair and active actors’ and stakeholders’ involvement should be properly granted and promoted, in order to achieve the full implementation of the so-called “multi-actor approach”. A wide range of general and specific innovative interventions to dissolve cultural barriers and specific lock-ins are needed to reach this ambitious goal. Differently, socio-economic actors will remain subaltern to research institutions due to inequality in roles and access to resources.
2. The impact of red tape on research and innovation projecting and implementation should be strongly mitigated; there is an urgent need that policymakers, acknowledging the issue, will rapidly proceed toward specific reforms. The disruptive effect of the misinterpretation and the erratic implementation of the state aids regulation to research and innovation by the regional and national authorities should be rapidly addressed.
3. The interaction among the national research communities operating in OFF within the universities and the other public and private research institutions should be promoted. To reach this objective, funding for research projects should be predominantly allocated via open research calls instead of direct assignments to the Mipaaf supervised public research institutions; only a minor share of funding (i.e., less than 15% and only in the case of pressing issues) should be used for direct project

assignments; moreover, in addition to pure research and innovation actions, national research programs should foresee opportunely designed research coordination and support actions.

4. The open-source approach should be put forward to enhance the impact of research and innovation. Indeed, as emerged from the World Cafè, the scientific results deserve to be predominantly published in accordance with the open-source policy. The release of open-source software and other digital tools should be promoted and the patent strategy applied to research and innovation products, including plant variety rights, opportunely limited.
5. To leverage the OFF sustainable growth in Italy, the national budget to fund research needs for this sector should be dramatically increased. Certainly, it should not be reduced, as it likely will happen if the bill 988/2018 is approved by the Italian Parliament. In addition, funding schemes able to foster the public-private partnership (i.e., crowdfunding for public research) should be designed and implemented.
6. The budget available in the next rural development programming phase should be more efficiently spent, avoiding inconsistency of approaches and timing across the Italian regions. Moreover, the spending devoted to OFF innovation projects (i.e. through the Operational Groups activation) should not be predetermined and constrained. Considering the increasing attractiveness and innovation capacity of organic food and farming, dedicated OGs should be granted unlimited capacity to compete for funding.
7. Last but not least, to ensure the scalability of impacts, research and innovation programs should be developed in order to seek their operational interconnection. In this regard, better coordination among national and regional authorities is a key element. Therefore, ritual State-Regions conferences should turn into strategic opportunities and be made open to substantial inputs from the OFF sector's representatives, envisioning participatory research and innovation governance.

We are aware that a more comprehensive understanding of the benefits achievable by effective, pertinent and consensual research and innovation for the Italian OFF sector needs further study. Indeed, in our work, we have not considered the direct and indirect role of the European research framework programs that, undoubtedly, might have interacted with the national research and innovation systems. Moreover, in order to fully assess the impacts of the research and innovation actions, specific metrics need to be developed or expanded through specific studies. Nevertheless, nowadays public research and innovation do not appear to be the key drivers of the OFF growth in Italy, as they could and would be; further efforts are necessary in order to grant the appropriate support that this very dynamic Italian food and farming sector deserves. A good starting point seems to be the recently announced Farm to Fork strategy [36], which is at the heart of the European Green Deal, since it will particularly boost sustainable farming systems such as organic farming. In particular, the strategy indicates the objective to reach at least 25% of the EU's agricultural land under organic farming by 2030.

We expect that the outcomes of our work will inspire policymakers and research managers to review their strategies and set appropriate guidelines to further promote quality research and effective innovation for organic food and farming in Italy. Finally, we are confident that the approach we have applied in our study can be exported and replicated in other countries to assess how research and innovation in OFF is implemented.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2073-4395/10/8/1181/s1>: Table S1: World Cafè Participants.

Author Contributions: S.C. (Stefano Canali) (conceptualization, data curation, formal analysis, methodology, writing original draft, review, and editing) had a major role in the conception and the design of the study, in the collection and analysis of the data about the research projects, in the interpretation of results, and in the drafting of the article. He contributed to designing, to organizing the World Cafè, and to analyzing the outcomes. S.C. (Simona Cristiano) and L.C. (conceptualization, data curation, formal analysis, methodology, writing original draft, review, and editing) had a major role in the conception and design of the study, in the collection and analysis of the data on the innovation projects, in the interpretation of the results, and in the drafting of the article. F.R. (data curation, formal analysis, writing, reviewing, and editing) contributed in collecting, analyzing, and interpreting the research project data. V.F., R.Z. and P.M. (writing, reviewing, and editing) contributed to the

design and organization of the World Café and its outcomes' analysis. D.A., M.D. and A.T. (writing, reviewing, and editing) contributed to the World Café outcomes' analysis and provided useful suggestions for the manuscript preparation. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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