

Article

Challenges and Action Points to Amplify Agroecology in Europe

Alexander Wezel ^{1,*} , Margriet Goris ², Janneke Bruil ², Georges F. Félix ² , Alain Peeters ³, Paolo Bàrberi ⁴ , Stéphane Bellon ⁵ and Paola Migliorini ⁶ 

¹ Department of Agroecology and Environment, ISARA, 23 rue Jean Baldassini, 69364 Lyon, France

² Cultivate!, Schuurhoven 29, 6721 SM Bennekom, The Netherlands; cocreation@live.nl (M.G.); jannekeb@dds.nl (J.B.); mr.georgesfelix@gmail.com (G.F.F.)

³ RHEA Research Centre, Rue Warichet 4 Box 202, 1435 Corbais, Belgium; alain.peeters.rhea@gmail.com

⁴ Institute of Life Sciences, Scuola Superiore Sant'Anna, Piazza Martiri della Libertà 33, 56127 Pisa PI, Italy; paolo.barberi@santannapisa.it

⁵ Ecodéveloppement, INRA, 84914 Avignon, France; stephane.bellon@inra.fr

⁶ University of Gastronomic Sciences, Piazza Vittorio Emanuele, 9, 12060 Pollenzo, Bra CN, Italy; p.migliorini@unisg.it

* Correspondence: awezel@isara.fr

Received: 14 April 2018; Accepted: 10 May 2018; Published: 16 May 2018



Abstract: Agriculture in Europe results in the production of food for both the European population and for the export sector. Significant environmental and social problems have emerged with the intensification of European agriculture. These include the loss of biodiversity, the contamination of soils, water, and food with pesticides, and the eutrophication of water bodies. Industrialized agricultural and food systems are also a major contributing factor in the decline of farm numbers, and the high use of antibiotics has led to serious human health problems. In this respect, agroecology can provide insights into important pathways and guide the design, development, and promotion of the transition towards sustainable farming and food systems. An analysis of the major challenges for the amplification of agroecology in Europe was carried out by 310 stakeholders in a World Café exercise and 23 sessions and workshops during the Agroecology Europe Forum 2017. The different challenges that were identified can be grouped into seven categories: (1) definition and concepts; (2) education, training, and knowledge sharing; (3) research approach and funding; (4) policies; (5) productivity and practices; (5) food systems and consumer awareness; and (6) co-optation. To address these challenges, the following key actions are recommended: (1) to develop a common understanding of agroecology; (2) to enhance education in agroecology and knowledge exchange; (3) to invest in agroecological research; (4) to develop policies enhancing agroecology; (5) to support new and existing agroecological practices; (6) to transform food systems; and (7) to strengthen communication and alliances. In this paper we present and discuss these recommendations for pathways and actions to develop sustainable agro-food systems in Europe through agroecology.

Keywords: actor networks; biodiversity-based farming; EU agricultural policy; food systems; participatory research; social movements; sustainable agriculture

1. Introduction

While Europe produces part of the food for its population, it has also become a major importer of soybean, vegetables and fruits, using large areas of agricultural land outside the continent. Europe also exports different food commodities such as milk and powder milk, poultry, pork, cereals, and high added-value foods and beverages [1]. This export (and European consumption) of milk, poultry, and

pork depends on the import of soybean for protein-rich livestock feed [2]. With the intensification of agriculture in the past five decades, yields have significantly increased. Meanwhile, environmental problems have emerged, such as the loss of biodiversity and natural habitats, pesticide contamination of soils, water, and food, and eutrophication of water bodies. Ongoing biodiversity loss in many countries in Europe, which to a large degree can be related to agriculture, includes habitat, pollinator, insect, and bird population loss [3–7]. Across the European Union (EU), more than three-quarters of wildlife habitat assessments indicate an unfavourable conservation status as a significant proportion of wildlife habitat continues to deteriorate [3]. This includes also habitats in agricultural landscapes. For species assessments, 60% of EU-level assessments indicate an unfavourable status for non-bird species [3]. More specifically for birds, the status of 15% of wild bird species is near-threatened, declining, or depleted, and another 17% are threatened [3]. Rare birds are not the only ones decreasing, as the decline in common and widespread species is also dramatic [8], and a downward trend for farmland birds is also shown [4]. Considering that two-thirds of European endangered or vulnerable bird species live exclusively in agroecosystems [9], sustainable agricultural management is of paramount importance to prevent their complete extinction [3,4]. The same challenges apply for pollinators. De Palma and colleagues [6] showed that half of all EU27 countries had lost over 10% of their average local bee species diversity and two-thirds of countries had lost over 5% of their average local functional and phylogenetic bee diversity. In pasture and higher-intensity cropland, diversity measures were generally lower than in semi-natural/natural vegetation. Agricultural practices, e.g., exposure to neonicotinoids, are associated with higher rates of bee population extinction [10].

Since the 1970s, a major issue has been the increasing degradation of water quality due to increasing nitrate and pesticide concentrations [11,12]. In particular, high nitrate contamination of groundwater resources was ascertained [13]. In many regions of Europe and in nearly all member states, nitrate concentrations of surface and underground water are still very high [2,14] even though the implementation of the Nitrates Directive (adopted in 1991) has led to some improvements. Eutrophication of the Baltic Sea, mainly due to intensive agriculture practices, is particularly problematic. The ecological status of water bodies is reported as critical [2]. In only one-third of all member states can over 50% of all natural surface water bodies be considered of good or high ecological quality.

Misuse of antibiotics in the animal husbandry sector is a serious issue in Europe, leading to the spread of antimicrobial resistance, with dangerous side-effects for human health [15]. Already more than a decade ago Roep and others [16] pointed out the risk of disconnecting agriculture from its ecological environment, of which the impact today is particularly evident in vegetable and fruit production and the pig and poultry sectors. Moreover, despite targeted policies, fertilizer and pesticide use has not declined in the latest 10 years, remaining stable or even increasing in some EU member countries [17–20].

In terms of socio-economic impacts, Oostindie et al. [21] and Van der Ploeg [22] question the economic sustainability of large-scale farms. Due to high levels of indebtedness of specialized, intensive and large farms, the buffer capacity of these farms is low and farms experience difficulties during high price fluctuations. Roep et al. [16] state that high-tech and capital intensive routes of transformation, aiming for high-output efficiencies in high-tech controlled production environments, imply not only high private but also high public costs and therefore a considerable risk of massive capital loss, with social capital included. Together with the aging of farmers, industrialized agricultural and food systems are a major driver of the ongoing fast decline of farmers and farm numbers in Europe [23].

The current situation clearly indicates that major changes are needed to develop sustainable agricultural and food systems in Europe. Agroecology could be an important approach to meet this goal, as it designs, develops, and promotes the transition towards biodiversity and low external input-based, socially sound farming and food systems. Currently, agroecology can be interpreted as a movement, as a scientific discipline, and also as a set of practices [24]. Various multilateral institutions and individual governments now use their own definitions of agroecology [25]. As a science, commonly

used definitions are: (1) *the integrative study of the ecology of the entire food systems, encompassing ecological, economic and social dimensions* [26]; (2) *the application of ecological concepts and principles to the design and management of sustainable food systems* [27]; and more recently (3) *the integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic, and social* [28]. As a set of agricultural practices, agroecology seeks ways to improve agricultural systems by imitating natural processes, creating beneficial biological interactions and synergies among the components of the agroecosystems [29], and use in the best way ecological processes and ecosystem services for the development and implementation of agroecological practices [30]. Moreover, agroecology is also seen as a transdisciplinary, participatory, and action-oriented approach [28,31]. As a movement, agroecology is seen as the answer to how to transform and repair the material reality in a food system and rural world that has been devastated by industrial food production and its so-called Green and Blue Revolutions. The diverse forms of smallholder food production based on agroecology generate local knowledge, promote social justice, nurture identity and culture, and strengthen the economic viability of rural areas. Agroecology is seen as a solution to modern crises (climate, malnutrition, etc.), not conforming to the industrial model but transforming it to build local food systems that create new rural–urban links based on fair and safe food production [32].

We use here the definition of the Association of Agroecology Europe which outlines agroecology as follows (www.agroecology-europe.org): *“Agroecology is considered jointly as a science, a practice and a social movement. It encompasses the whole food system from the soil to the organization of human societies. It is value-laden and based on core principles. As a science, it gives priority to action research, holistic and participatory approaches, and transdisciplinarity including different knowledge systems. As a practice, it is based on sustainable use of local renewable resources, local farmers’ knowledge and priorities, wise use of biodiversity to provide ecosystem services and resilience, and solutions that provide multiple benefits (environmental, economic, social) from local to global. As a movement, it defends smallholders and family farming, farmers and rural communities, food sovereignty, local and short marketing chains, diversity of indigenous seeds and breeds, healthy and quality food.”*

This paper reviews and summarises major challenges and proposals for agroecology to best contribute to the transition towards sustainable agricultural and food systems in Europe as they emerged at the Agroecology Europe Forum 2017. It presents various actions to amplify agroecology in Europe.

2. Defining and Determining Major Challenges and Key Actions

Major challenges for the development of sustainable agriculture and food systems, and more specifically the amplification of agroecology, as well as the actions needed to promote it, were highlighted by 310 stakeholders (mainly researchers and students, but also farmers, technicians, political decision-makers, representatives of national and European institutions, non-governmental organizations and social movements organisations) in a plenary ‘World Café’ exercise, as well as 23 other sessions and workshops during the first Agroecology Europe Forum, organised in Lyon, France, in October 2017. The World Café is a participatory method that attempts to achieve collective change by bringing a large number of stakeholders together in one place, using a highly structured process to create flexible and co-evolving networks of conversations and discussions [33]. During the World Café in Lyon, participants were divided into two large groups of around 150 people each, consisting of ‘table groups’ with five persons, with a change in composition after each question. In each of the around 60 tables, perspectives and proposals were shared and notes were taken.

At each question and round each participant presented herself/himself followed by a short individual reflection on the question. Then, a discussion within the group took place, followed by a synthesis agreed on by the group. For this, the ‘host’ of the table (determined by the participants at the beginning of all rounds) wrote down the key points and ideas that emerged, which the group agreed on to share at the final plenary roundtable. These written summaries were given to the organisers of the World Café and used as data for the present paper. After the three rounds of questions, a final

plenary round of presentations with all participants in the two larger groups informed the respective audiences about the main outcomes of the table groups. This information was given by the hosts of the tables. Moreover, participants could make additional comments if they felt that some element raised in their table group was missing. These comments and other discussion points were also noted down by the organisers. The entire process of the World Café took 2 h.

The questions asked during the World Café were: (1) What are the two/three most important challenges for agroecology today? (2) What are the key actions needed in Europe to amplify agroecology? (3) How can you, and your institution, contribute to the amplification of agroecology? In this paper, we present the results of questions (1) and (2).

In addition to the World Café outcomes, summaries of all 23 sessions and workshops on a variety of topics related to agroecology inside and outside of Europe (<http://www.agroecology-europe.org/agroecology-forum-2017>) were collected. This includes forum sessions, which consisted of 4–5 presentations of 10 min each, followed by discussion. Workshops included 3–5 talks of 5 min to allow room for discussion and debate. Key findings and proposed actions were summarized at the end of each session and workshop.

This paper includes a summary of all outcomes of the various elements that made up the Forum. Although many inputs and ideas were generated, there was no subsequent process to agree on outcomes, priorities, or recommendations among participants. As such, this paper does not claim that the points shown below represent the consolidated views of all 310 participants, but is rather meant as a non-exhaustive overview of prevalent issues and emerging proposals as well as a sample of the diversity of opinions.

3. Most Important Challenges for Agroecology Today

Many challenges were identified for the development and amplification of agroecology in Europe. These challenges can be grouped into several categories as illustrated in Figure 1.

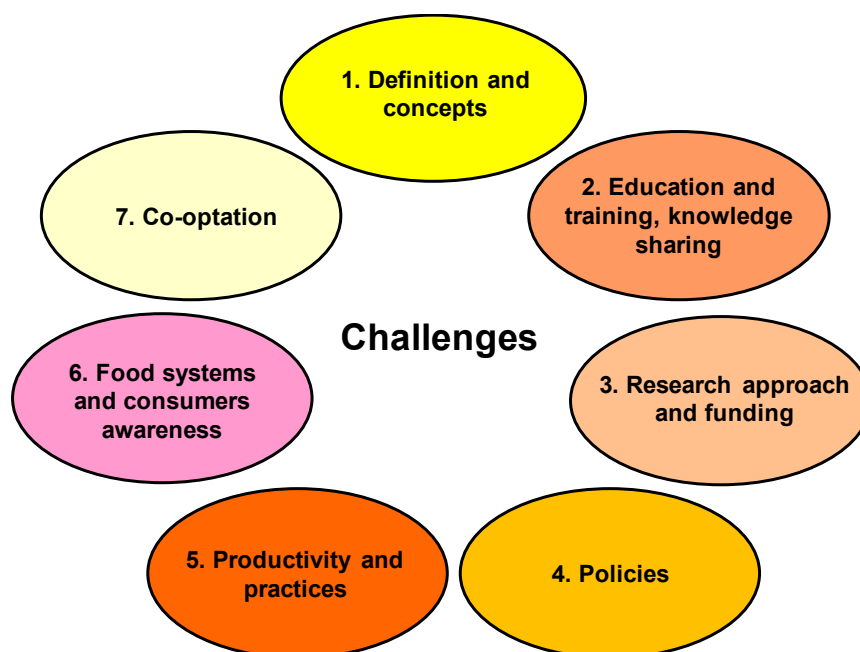


Figure 1. Major challenges to agroecology in Europe.

The first challenge identified by participants is the lack of a common, broadly accepted definition of agroecology. Although various definitions exist, and some of them are regularly used and cited (e.g., [24,26,27,34]), the interpretations and understanding of the concepts behind them can be perceived

quite differently by different actors, also because they are involved in different 'agroecologies' which reflect the diversity of contexts in Europe and in fact, the world. Thus, a major challenge is to establish a common understanding of what agroecology is and what it implies as a practice, a science, and a socio-political movement. This also includes making clearer what the commonalities and differences are between agroecology and organic agriculture, one of the production methods that is often associated with agroecology [35].

A second challenge was identified as education and training in agroecology. Although there is an increasing number of study and training programmes in agroecology [36], a big challenge is to integrate this into more classical, mainstream agronomy and rural development studies, and overall interdisciplinary agriculture and food science programmes at all levels, to educate future actors in sustainable agriculture and food systems. Agroecology training programmes for, by, and with farmers are still judged to be underdeveloped in number and size. Another important challenge is how to better foster knowledge sharing amongst farmers, researchers, and educators as well as knowledge creation by farmers and its subsequent documentation and integration into training or education programmes.

The third category of challenges concerns research. There is a clear lack of widespread, interdisciplinary agroecology research. Although growing, funding is still limited at the EU level and is nearly absent in some countries. Only very recently have some funding programmes included elements for agroecological research. A big difficulty is that agroecology research deals with complexity and diversity, and requires systems, holistic, and participatory approaches. Thus, a variety of factors need to be taken into account, such as integrating natural and social science approaches, analyses, and evaluations, and overcoming researchers' reluctance in getting engaged in long-term, multidisciplinary research programmes. Another related challenge is how to engage more farmers with research in a meaningful way [37].

There is still a widespread belief that agroecology means less productivity, lower yields, and more labour, or that it represents a non-viable alternative to current ways of food production [38]. Overcoming this notion, by improved communication and through bringing on board new allies, is another key challenge. Participants stated that it is important to create awareness that a balance between economic value and stability of production can be achieved with agroecological farming. This implies broadening support for and interest in agroecology and its potential by conventional farmers and science, as well as the promotion of a supportive discourse on agroecology through giving visibility to the contributions of existing successful practices and farms, and identification of promising agroecological socio-technical innovations. As an overarching goal, participants called for agroecology to become the main innovation paradigm in agriculture.

Another category of challenges concerns policies. The participants at the Lyon Forum argued that there is an urgent need to put agroecology on the political agenda of the EU, and more specifically to integrate agroecology firmly in the new Common Agricultural Policy (CAP) after 2020. An important challenge is that policies at the EU level, and also at national levels, have so far mainly supported an economic system that is more favourable to large-scale, high-input, and capital-intensive agriculture, thus impeding or not facilitating the transition to agroecological farming systems, thereby threatening in particular the future of family farming, which is seen by most stakeholders as the target group for agroecological farming. Moreover, the connections between farmers, science, and policy makers are too weak to provide effective local solutions, or local adaptations of national and European policies.

A sixth domain of challenges was identified around food systems. Agroecology is part of whole food systems that go beyond production, and thus the amplification of agroecology requires more development of concepts and actions at the food systems level [23]. One challenge is to (re)connect farmers with urban dwellers, increasing awareness of consumers about the impact of their eating and buying habits, the (nutritional) quality of their food and the way it is produced, and promoting regionally-oriented food systems.

One last type of challenge is the possible co-optation and misuse of the term 'agroecology' by the agriculture and food industry, conservative farmer associations or cooperatives, and governments,

risking a watering down of the essence of agroecology as a science, movement, and practice. A related challenge is the intensive lobby of large corporations for a favourable legal and economic framework for industrialized, large-scale, standardized, and specialized agricultural and food systems, which work in opposition to the diversification inherent in agroecology [39].

4. Key Actions Needed in Europe to Amplify Agroecology

In order to develop sustainable agriculture and food systems substantial changes are needed, for which agroecology can offer manifold contributions provided it is scaled up, or amplified. The Table below shows several key actions, defined by a large group of stakeholders, to amplify agroecology in Europe and to contribute to the transition to more sustainable agro-food systems (Table 1).

The first category of actions needed to amplify agroecology in Europe is to develop a common understanding of agroecology and to build a strong narrative to better showcase the contributions of in agroecology in the current context of multifaceted crises.

Second, education in agroecology and knowledge exchange must be enhanced, experiential and on-farm learning stimulated, and improved methods for co-creation and exchange of knowledge developed.

Third, increased investment in agroecological research is needed. The different actions to be developed include supporting more academics working for and with farmers, involving them in the formulation of research questions and projects, conducting more transdisciplinary action-research and creating participatory platforms, enlarging long-term field experiments, and changing evaluation criteria and funding of research projects and researchers.

The fourth category of actions relates to policy development which enhances agroecology. For this, the Common Agricultural Policy (CAP) needs to be re-designed, and other policies implemented, including payment schemes for farmers which provide ecosystem services, fair prices paid to farmers for their products, and support for farmers' organisations working with an agroecological perspective.

The fifth category of actions that were identified emphasises support for new and existing agroecological practices and farms. Alternatives to herbicides and pesticides must be developed. Moreover, pioneer farmers should be identified that can showcase their work to other farmers, while young farmers and small-scale entrepreneurship must be supported.

The sixth category of actions aims to transform the food systems. A critical mass of consumers has to be built to influence policies and markets for agroecological produce. The public sector can take important steps to purchase local agroecologically produced food. Further, taxation for non-sustainable food and an orientation of CAP subsidies towards quality food are other mentioned actions, as well as strengthening relations between urban citizen and farmers.

The last category refers to the strengthening of communication and alliances. Agroecological practices and their multidimensional contributions need to be promoted, quantified, and disseminated much more. To that end, communication efforts should inform people about techniques, practices, positive impacts, obstacles and opportunities, and emblematic cases. Further, participants stated it is of great importance to bring together different representatives of farmers and other stakeholder groups and build alliances and networks.

Table 1. Key actions needed in Europe to amplify agroecology.

Category of Action	Actions Defined by World Café Participants
1. Develop common understanding of agroecology	<ul style="list-style-type: none"> • Develop a clearer definition and common understanding of agroecology at local, national, and European levels. • Build a strong narrative around the multidimensional character and contributions of agroecology.
2. Enhance education in agroecology and knowledge exchange	<ul style="list-style-type: none"> • Enhance education on agroecology at vocational schools and universities. • Stimulate experiential and on-farm learning. • Develop and improve methods for co-creation and exchange of knowledge, e.g., co-design knowledge exchange methods with farmers and between farmers, students, researchers, and other actors.
3. Invest in agroecological research	<ul style="list-style-type: none"> • Identify and support more academics working for and with farmers. • Farmers should formulate what are for them the most relevant research questions and be involved in research programmes and projects from the start. • Carry out more transdisciplinary action research. • Create participatory platforms where farmers, researchers, and other actors work together. • Extend long-term field experiments with agroecological systems and establish networks. • Change evaluation criteria and funding of research projects and researchers by taking into account to what extent farmers are engaged in the production of tools, to what extent they include participatory action research and sharing of knowledge, and how they respond to research questions of farmers and other actors in territories.
4. Develop policies which enhance agroecology	<ul style="list-style-type: none"> • Transform and re-design the Common Agricultural Policy (CAP) in order to include support for agroecological approaches. • Develop diverse policies suited for support of agroecology at local, regional, and national levels, including fair prices for farmers. • Develop new systems for the ecological, economic, social, and technical impact assessment of agroecology. • Establish payment schemes for farmers for managing and conserving biological and cultural diversity, as they perform ecosystem services for society. • Support farmers' organisations working in agroecology. • Develop governance mechanisms that can articulate agricultural, food, health, social, and environmental policies (examples of Brazil and Lyon's food council).
5. Support new and existing agroecological practices and farms	<ul style="list-style-type: none"> • Support a systems re-design approach and good agroecological practices. • Demonstrate agroecological alternatives for glyphosate and other herbicides and pesticides. • Identify pioneer farmers that are interested in showing other farmers how agroecological farming can be done while ensuring profitability and a good livelihood. • Develop and support small-scale agroecological farms and entrepreneurship and local processing of food and raw materials. • Support young people and entrepreneurs both in farming and processing and commercialisation.
6. Transform food systems	<ul style="list-style-type: none"> • Build a critical mass of consumers to influence policies and markets for agroecological produce. • Strengthen the role of agroecology in the food chain—enable consumers to recognise and value food that comes from agroecological production. • Involve the public sector in purchasing agroecological produce and products (e.g., via public procurement). • Develop taxation for non-sustainably produced food. Concentrate CAP subsidies for quality food and other ecosystem services. • Close the gap between urban citizens and farmers, e.g., through support innovative regional market arrangements, open days at farms, and various forms of community-supported agriculture.
7. Reinforce communication and alliances	<ul style="list-style-type: none"> • Quantify and disseminate results of agroecological practices. • Promote agroecological practice through farming styles that currently exist (but may be named differently). • Enhance communication on agroecology at different levels and amongst different actors. • Disseminate information about agroecological initiatives, techniques, and practices among interested actors. • Inform people in Europe about the positive impacts of agroecology by using emblematic cases and getting stories in the media. • Strengthen alliances among different actors and actor networks in agroecology. • Bring representatives of farmers, other food producers, small scale processors, researchers, and concerned citizens together to enhance the social movement for a sustainable food system in Europe.

5. Discussion

The challenges for agroecology in Europe and the key actions needed to overcome them in order to amplify agroecology are manifold, according to the insights generated at the Agroecology

Forum. The challenges concern different scales, from local to European, and different levels, from the production techniques to the organisation of food systems. Therefore, there is a strong need for an agroecological movement which engages many and diverse actors [22,40]. The central actors in this movement are farmers and other food producers, (urban) consumers, social movements, NGOs, researchers and supportive policy makers. Farmers and other food producers are key because they are the most affected by Europe's current food and farming system, and can practice agroecology. They also have a wealth of associated knowledge to share among them and with others, and contribute to crucial embedded learning and dissemination processes. Consumers are significant because they are a potential force for change through choosing the food they want to eat, engaging in supportive institutional market arrangements, and impacting policy decisions. Social movements are crucial for building alliances developing political positions and creating power to mobilise large groups of concerned and organised people. Researchers can document and analyse the social and ecological processes inherent in agroecology and play a role in the co-creation of new knowledge. Finally, connections with policy makers are imperative as they are crucial for the integration of and institutional support for agroecology in different socio-economic sectors.

Overall, participants in the First Agroecology Europe Forum clearly called for better knowledge exchange amongst the diverse actors. They aim at reaching not only environmental sustainability and social justice but also cognitive justice. Cognitive justice encompasses not only the right of different practices to co-exist but entails an active engagement across their knowledge systems [41]. This means for instance the recovery and co-production of contextualised, environment-specific knowledge, supported by co-learning between farmers, students and researchers—essential for the spread of agroecology. Educational reform, expansion of education to agroecology, and the fostering of new ways of learning (such as on-farm education), can and should be co-developed with farmers on topics such as functional biodiversity, local breeds and seeds and agroforestry, amongst other things.

With regard to the development of policies in favour of agroecology, there are ongoing debates related to the future of agriculture in Europe. One is the large debate on the ban of glyphosate in Europe. Although the EU commission decided, with a small majority of member country votes, to postpone a possible ban of five years, some member countries such as France and Italy stated that they still want to continue to implement it [42]. This is a crucial issue for farmers as many of their systems rely on using herbicides, and in particular on glyphosate. Farmers have the option to either substitute glyphosate with other herbicides, or to change to weed control practices without herbicide use. For the latter option, the agroecological approach can provide suitable and effective alternatives. Participants did not formulate specific types of policies in favour of agroecology but the comments in general and the literature review indicate the need for policies to support the transition towards agriculture that is non-reliant on the use of glyphosate, and other herbicides therefore need to be developed, as well as a policy on agricultural extension which supports knowledge exchange amongst farmers (including on alternatives to herbicides and pesticides). European, national, and regional funding should be made available to finance universities, farmer organizations, and NGOs who organise and systematise knowledge exchanges amongst farmers and with researchers. This is one possible pathway of supporting this transition. Other types of policies, notably those that are cross-sectoral and integrate health, nutrition, education, urban planning, land governance and other issues, should be explored with farmers, researchers, social movement organizations, and other actors to verify needs, potential support, and ways of implementation.

Agroecological farming is not merely about environmental sustainability but encompasses a holistic view of farming, connecting production with biological and cultural diversity as well as enhancing local social and economic relations. This has been clearly shown by farmers in the Global South [43,44] where agroecology is often more developed, but is also true for Europe. This point has also been illustrated by De Schutter [45] and Van der Ploeg [22], arguing that the agroecological, peasant mode of farming is able to offer more people a better living in rural areas than 'industrialized',

'conventional' or 'capitalist' farming, while also creating new ties with and healthy food options for urban citizens.

Another important debate is taking place around the digital revolution, big data and technology in agriculture. How will this change agricultural production, the profession and work of farmers, and economic and technological investments of family farms or farm enterprises? Can the use of big data and technology be in agreement with and supportive of agroecological principles and approaches? Discussions so far show that there are very contrasting positions on this issue.

Finally, we come to a critical reflection about representativeness of defined challenges and actions. The procedure of the World Café gave a voice to every participant to provide her/his opinion on three central questions around the amplification of agroecology. The synthesis made at the end of each round was based on a common agreement of participants on key ideas emerging from the group. Although the note-takers might have given more priority to certain results, each participant had some possibility during the plenary discussion at the end of the World Café to indicate any point they felt to have been overlooked in the synthesis. However, the process did not allow for the development of agreement on all points or a priority list of actions needed as data collection was qualitative. No counting of the mentioning of certain actions was included in the procedure of the World Café. That said, the process did generate an overview of the diversity of perceived challenges and actions needed.

During the World Café there were also statements of participants which clearly showed their different expectations, demands, levels of knowledge, and priorities regarding challenges and actions needed for agroecology in Europe. This paper does not aim to value the statements made. For example, various participants claimed that there is a lack of widespread, interdisciplinary agroecology research. Although it might be true that interdisciplinary research is still not sufficiently developed, there are many ongoing interdisciplinary research efforts [36,46] of which non-academia stakeholders might not be aware. Also, some participants claimed that there exists no broad commonly accepted definition of agroecology and that it should be developed. This is not astonishing when taking into account the large diversity of agroecology in Europe or other countries of the world. Many of the stakeholders might have their own forms of 'agroecologies', therefore using the definitions they prefer. There is now a large number of definitions [25], although we see more and more convergence.

6. Conclusions

Agriculture in Europe produces large amounts of food for European populations, and has become a major export sector (while Europe also imports large quantities of food). With the intensification of agriculture in Europe, significant environmental and social problems have emerged, such as the loss of biodiversity, pesticide contamination of soils, water, and food, and eutrophication of water bodies. Industrialised agricultural and food systems are also a major contributing factor in the decline of farm numbers in Europe, and high use of antibiotics has led to serious human health problems. In this respect, agroecology can provide insights into important pathways and guide the design, development, and promotion of the transition towards sustainable farming and food systems.

The various challenges for the development and amplification of agroecology in Europe that were identified by a large group of participants at the Agroecology Forum 2017 in Lyon can be grouped into seven categories: (1) definition and concepts; (2) knowledge sharing, education and training; (3) research approach and funding; (4) policies; (5) productivity and practices; (6) food systems and consumer awareness; and (7) co-optation. To overcome these challenges, the following types of key actions are needed from the local to the European level: (1) to develop common understanding of agroecology; (2) to enhance education in agroecology and knowledge exchange; (3) to invest in agroecological research; (4) to support new and existing agroecological practices; (5) to develop policies to enhance agroecology; (6) to transform food systems; and (7) to strengthen communication and alliances. Although large challenges exist in Europe to develop more sustainable agro-food systems, different pathways and actions are available to reach this goal.

Author Contributions: A.W. is the main writer of this paper and made the main analysis of the data. M.G., J.B., G.F.F. and A.P. collected the data for the World Café (together with A.W.), summarized it, and contributed significantly for writing of the paper. The other authors contributed to writing and editing of the paper.

Acknowledgments: We are grateful for the many contributions of the more than 310 participants at the Agroecology Europe Forum 2017. We also particularly thank the convenors of sessions and workshops in working out key actions related to different domains and topics in agroecology. We highly acknowledge the work of the MSc Agroecology students at ISARA, Lyon, France, who were taking notes during all sessions and workshops and who provided summaries of each. We also thank three reviewers for their valuable comments and suggestions to improve the paper.

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

References

1. Eurostat. *Agriculture, Forestry and Fishery Statistics*; Publications Office of the European Union: Luxembourg, 2017; p. 170.
2. Taelman, S.E.; De Meester, S.; Van Dijk, W.; da Silva, V. Environmental sustainability analysis of a protein-rich livestock feed ingredient in The Netherlands: Microalgae production versus soybean import. *Resour. Conserv. Recycl.* **2015**, *101*, 61–72. [CrossRef]
3. European Commission. *The EU Environmental Implementation Review: Common Challenges and How to Combine Efforts to Deliver Better Results*; European Commission: Brussels, Belgium, 2017; p. 802. Available online: http://ec.europa.eu/environment/eir/pdf/full_report_en.pdf (accessed on 21 January 2018).
4. Pe'er, G.; Dicks, L.V.; Visconti, P.; Arlettaz, R.; Báldi, A.; Benton, T.G.; Collins, S.; Dieterich, M.; Gregory, R.D.; Hartig, F.; et al. EU agricultural reform fails on biodiversity. *Science* **2014**, *344*, 1090–1092. [CrossRef] [PubMed]
5. Potts, S.; Biesmeijer, K.; Bommarco, R.; Breeze, T.; Carvalheiro, L.; Franzén, M.; González-Varo, J.P.; Holzschuh, A.; Kleijn, D.; Klein, A.-M.; et al. *Status and Trends of European Pollinators. Key Findings of the STEP Project*; Pensoft Publishers: Sofia, Bulgaria, 2015; p. 72. Available online: <http://step-project.net/img/uplf/STEP%20brochure%20online-1.pdf> (accessed on 21 January 2018).
6. De Palma, A.; Kuhlmann, M.; Bugter, R.; Ferrier, S.; Hoskins, A.J.; Potts, S.G.; Roberts, S.P.M.; Schweiger, O.; Purvis, A. Dimensions of biodiversity loss: Spatial mismatch in land-use impacts on species, functional and phylogenetic diversity of European bees. *Divers. Distrib.* **2017**, *23*, 1435–1446. [CrossRef] [PubMed]
7. IPBES. *Summary for Policymakers of the Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*; Fischer, M., Rounsevell, M., Torre-Marín Rando, A., Mader, A., Church, A., Elbakidze, M., Elias, V., Hahn, T., Harrison, P.A., Hauck, J., et al., Eds.; IPBES Secretariat: Bonn, Germany, 2018; Available online: <http://www.db.zs-intern.de/uploads/1523006347-IPBESregionalsummaryEurope.pdf> (accessed on 8 April 2018).
8. Gross, M. Europe's bird populations in decline. *Curr. Biol.* **2015**, *25*, R483–R485. [CrossRef]
9. Tucker, G.M.; Heath, M.F. *Birds in Europe. Their Conservation Status*; Birdlife Conservation Series No 3; Birdlife International: Cambridge, UK, 1994.
10. Woodcock, B.A.; Isaac, N.J.B.; Bullock, J.M.; Roy, D.B.; Garthwaite, D.G.; Crowe, A.; Pywell, R.F. Impacts of neonicotinoid use on long-term population changes in wild bees in England. *Nat. Commun.* **2016**, *7*, 12459. [CrossRef] [PubMed]
11. European Commission. *Implementation of Council Directive 91/676/EEC Concerning the Protection of Waters against Pollution Caused by Nitrates from Agricultural Sources*; Synthesis from year 2000 Member States reports; Office for Official Publications of the European Communities: Luxembourg, 2002; p. 44. Available online: <http://ec.europa.eu/environment/water/water-nitrates/report.html> (accessed on 21 January 2018).
12. European Environment Agency. *Europe's Water: An Indicator-Based Assessment*; European Environment Agency: Copenhagen, Denmark, 2003; p. 97. Available online: http://www.eea.europa.eu/publications/topic_report_2003_1 (accessed on 21 January 2018).
13. Lerner, D.N.; Harris, B. The relationship between land use and groundwater resources and quality. *Land Use Policy* **2009**, *26*, 265–273. [CrossRef]

14. European Commission. *Report from the Commission to the Council and the European Parliament. On Implementation of Council Directive 91/676/EEC Concerning the Protection of Waters against Pollution Caused by Nitrates from Agricultural Sources Based on Member State Reports for the Period 2004–2007*; European Commission: Brussels, Belgium, 2011; p. 10. Available online: <http://ec.europa.eu/environment/water/water-nitrates/pdf/swd.pdf> (accessed on 21 January 2018).
15. ECDC (European Centre for Disease Prevention and Control), EFSA (European Food Safety Authority) and CVMP (EMA Committee for Medicinal Products for Veterinary Use). ECDC, EFSA and EMA joint scientific opinion on a list of outcome indicators as regards surveillance of antimicrobial resistance and antimicrobial consumption in humans and food-producing animals. *EFSA J.* **2017**, *15*, e05017. [[CrossRef](#)]
16. Roep, D.; Van der Ploeg, J.D.; Wiskerke, J.S.C. Managing technical-institutional design processes: Some strategic lessons from environmental co-operatives in the Netherlands. *Wagening. J. Life Sci. (NJJAS)* **2003**, *51*, 195–217. [[CrossRef](#)]
17. Eurostat. Agri-Environmental Indicator—Mineral Fertiliser Consumption. 2017. Available online: http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_mineral_fertiliser_consumption (accessed on 12 February 2018).
18. Eurostat. Agri-Environmental Indicator—Consumption of Pesticides. 2017. Available online: http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_consumption_of_pesticides (accessed on 12 February 2018).
19. FAO. *World Fertilizer Trends and Outlook to 2018*; FAO: Rome, Italy, 2015; p. 66. Available online: <http://www.fao.org/3/a-i4324e.pdf> (accessed on 12 February 2018).
20. PAN Europe (Pesticide Action Network Europe). Pesticide Use in Europe. 2018. Available online: <https://www.pan-europe.info/issues/pesticide-use-europe> (accessed on 21 January 2018).
21. Oostindie, H.; Van der Ploeg, J.D.; Van Broekhuizen, R. *Buffercapaciteit: Bedrijfsstijlen in de Melkveehouderij, Volatile Markten en Kengetallen*; University of Wageningen: Wageningen, The Netherlands, 2013.
22. Van der Ploeg, J.D. *The Importance of Peasant Agriculture: A Neglected Truth*; Wageningen University & Research: Wageningen, The Netherlands, 2017; p. 27.
23. European Union. *EU Farms and Farmers in 2013: An Update*; EU Agricultural and Farm Economics Briefs; European Union: Brussels, Belgium, 2015; p. 8.
24. Wezel, A.; Bellon, S.; Doré, T.; Francis, C.; Vallod, D.; David, C. Agroecology as a science, a movement or a practice. A review. *Agron. Sustain. Dev.* **2009**, *29*, 503–515. [[CrossRef](#)]
25. FAO. Agroecology Knowledge Hub. Agroecology Definitions. 2017. Available online: [http://www.fao.org/agroecology/knowledge/definitions/en/?page=1&ipp=6&no_cache=1&tx_dynalist_pi1\[par\]=YToxOntzOjE6IkwiO3M6MToiMCI7fQ](http://www.fao.org/agroecology/knowledge/definitions/en/?page=1&ipp=6&no_cache=1&tx_dynalist_pi1[par]=YToxOntzOjE6IkwiO3M6MToiMCI7fQ) (accessed on 8 April 2018).
26. Francis, C.; Lieblein, G.; Gliessman, S.; Breland, T.A.; Creamer, N.; Harwood, R.; Salomonsson, L.; Helenius, J.; Rickerl, D.; Salvador, R.; et al. Agroecology: The ecology of food systems. *J. Sustain. Agric.* **2003**, *22*, 99–118.
27. Gliessman, S.R. *Agroecology: The Ecology of Sustainable Food Systems*; CRC Press, Taylor & Francis: New York, NY, USA, 2007; p. 384.
28. Gliessman, S. Defining Agroecology. *Agroecol. Sustain. Food Syst.* **2018**, *42*, 599–600. [[CrossRef](#)]
29. Gliessman, S.R. *Agroecology: Researching the Basis for Sustainable Agriculture*; Springer: New York, NY, USA, 1990.
30. Wezel, A.; Casagrande, M.; Celette, F.; Vian, J.F.; Ferrer, A.; Peigné, J. Agroecological practices for sustainable agriculture. A review. *Agron. Sustain. Dev.* **2014**, *34*, 1–20. [[CrossRef](#)]
31. Méndez, V.E.; Bacon, C.M.; Cohen, R. Agroecology as a transdisciplinary, participatory, and action-oriented approach. *Agroecol. Sustain. Food Syst.* **2013**, *37*, 3–18.
32. La Via Campesina. Declaration of the International Forum for Agroecology. 2015. Available online: <https://viacampesina.org/en/new-peoples-declaration-brings-common-understanding-of-agroecology/> (accessed on 8 April 2018).
33. Jorgenson, J.; Steier, F. Frames, framing, and designed conversational processes: Lessons from the World Café. *J. Appl. Behav. Sci.* **2013**, *49*, 388–405. [[CrossRef](#)]
34. Altieri, M.A. *Agroecology: The Science of Sustainable Agriculture*; Westview Press: Boulder, CO, USA, 1995; p. 433.
35. Migliorini, P.; Wezel, A. Converging and diverging principles and practices of organic agriculture regulations and agroecology. A review. *Agron. Sustain. Dev.* **2017**, *37*, 63. [[CrossRef](#)]

36. Wezel, A.; Goette, J.; Lagneaux, E.; Passuello, G.; Reisman, E.; Rodier, C.; Turpin, G. Agroecology in Europe: Research, education, collective action networks, and alternative food systems. *Sustainability* **2018**, *10*, 1214. [[CrossRef](#)]
37. Ortolani, L.; Bocci, R.; Bàrberi, P.; Howlett, S.; Chable, V. Changes in knowledge management strategies can support emerging innovative actors in organic agriculture: The case of participatory plant breeding in Europe. *Org. Farming* **2017**, *3*, 20–33. [[CrossRef](#)]
38. Timmerman, C.; Félix, G.F. Agroecology as a vehicle for contributive justice. *Agric. Hum. Values* **2015**, *32*, 523–538. [[CrossRef](#)]
39. IPES Food. From Uniformity to Diversity: A Paradigm Shift from Industrial Agriculture to Diversified Agroecological Systems. International Panel of Experts on Sustainable Food Systems, 2016; p. 96. Available online: http://www.ipes-food.org/images/Reports/UniformityToDiversity_FullReport.pdf (accessed on 21 January 2018).
40. Rosset, P.M.; Martinez-Torres, M.E. Rural social movements and agroecology: Context, theory and process. *Ecol. Soc.* **2012**, *17*, 17. [[CrossRef](#)]
41. Coolsaet, B. Towards an agroecology of knowledges: Recognition, cognitive justice and farmers' autonomy in France. *J. Rural Stud.* **2016**, *47*, 165–171. [[CrossRef](#)]
42. Politico. French and Italians Sense Golden Opportunity in Glyphosate Ban. 2017. Available online: <https://www.politico.eu/article/french-and-italians-sense-golden-opportunity-in-glyphosate-ban/> (accessed on 7 March 2018).
43. Botelho, M.I.V.; Cardoso, I.M.; Otsuki, K.L. I made a pact with God, with nature, and with myself: Exploring deep agroecology. *Agroecol. Sustain. Food Syst.* **2016**, *40*, 116–131. [[CrossRef](#)]
44. Escobar, A. *Territories of Difference, Place, Movements, Life, Redes*; Duke University Press: Durham, NC, USA, 2008; p. 456.
45. De Schutter, O. Promotion and Protection of All Human Rights, Civil, Political, Economic, Social and Cultural Rights, Including the Right to Development, United Nations Report Submitted by the Special Rapporteur on the Right of Food, Olivier de Schutter at the Human Rights Council, 16th Session, 21p. 2010. Available online: <http://www2.ohchr.org/english/issues/food/docs/A-HRC-16-49.pdf> (accessed on 21 January 2018).
46. Nicot, R. Les Réseaux Européens D'acteurs de la Recherche et de la Formation en Agroécologie. Master's Thesis, Université de Paris-Est Marne-la-Vallée, Paris, France, 2017.



© 2018 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

© 2018. This work is licensed under
<https://creativecommons.org/licenses/by/4.0/> (the “License”).
Notwithstanding the ProQuest Terms and Conditions, you may use this
content in accordance with the terms of the License.