

RESEARCH ARTICLE

How do policy-influential stakeholders from the Madrid region (Spain) understand and perceive the relevance of agroecology and the challenges for its regional implementation?

Ana Márquez-Barrenechea¹, Marina García-Llorente^{1,2,3}, Xavier López-Medellín⁴, Franco Llobera⁵, Manuel Redondo⁶

Received: March 31, 2020
Revised: August 7, 2020
Revised: December 22, 2020
Accepted: December 23, 2020

HIGHLIGHTS

- We studied the agroecological understanding and impact in the Madrid region.
- Four participatory workshops were conducted with policy-influential stakeholders
- Agroecological meaning was associated predominantly with environmental elements.
- Agroecology needs to be institutionalised, strengthening the productive sector in connection with local consumers.

KEYWORDS agroecology, agroecosystem, decision-making, multifunctional landscape, participatory workshop, rural development, transition

Abstract

Due to the high population growth rates and the negative impacts of the current agrifood production model, alternatives emerge to feed the current and future world population in a sustainable way. One of the proposed approaches is agroecology, understood as a scientific discipline, a set of agricultural practices and a socio-political movement that enhances the sustainability of agroecosystems from a holistic perspective. Agroecology was born and grew along the 20th century, and nowadays it is gaining legitimacy at different levels. However, agroecology is still an unknown concept in several influential fields. This paper attempts to study the impact of agroecology in the Madrid region and the main challenges and strategies to encourage its transition. We analysed the understanding and perceived

challenges of the agroecological transitions of stakeholders whose role is crucial in the political sphere, through four participatory workshops conducted in October–November 2019 (n=79 attendees). Among the main findings it is remarkable the high agroecological understanding of the attendees. This concept is predominantly associated with environmental elements with less relevance of social and governance elements. One of the major challenges to be tackled is the lack of legal framework on agroecological issues. Additionally, consumers were considered essential as they contribute to the creation of demand for agroecological products, yet, the small productive sector is working precariously. Thus, the communication with these producers must be enhanced as well as their profession dignified. The institutionalisation of agroecology and the implementation of public policies are decisive factors for the agroecological transition.

¹ Social-Ecological Systems Laboratory, Department of Ecology, Autonomous University of Madrid, Spain

² FRACTAL Collective, Madrid, Spain

³ Department of Applied Research and Agricultural Extension, Madrid Institute for Rural, Agricultural and Food Research and Development (IMIDRA), Alcala de Henares, Madrid, Spain

⁴ Centro de Investigación en Biodiversidad y Conservación, Universidad Autónoma del Estado de Morelos, México

⁵ Asociación Economías BioRegionales, Madrid, Spain

⁶ MÉRCODES Mercado-Comunicación-Desarrollo, Cercedilla, Spain

1 Introduction

Demographic projections hold that in 2050 the world's population will be $9.7 \cdot 10^9$ people. In response to the population's demand for food, a highly productive agroindustrial model has been promoted for decades following the Green Revolution (Borlaug, 1971). Recently, however, the academic, political and activist world are working to find alternatives to this model in order to feed the current and future population in an environmentally sustainable and socially equitable manner (Gliessman, 2015). Likewise, according to Delgado Cabeza (2010), the current agrifood system is not capable of feeding the entire world population either, since there are still problems related to hunger and malnutrition. The prevailing agroindustrial model has not paid enough attention to the negative social and environmental consequences of its production system (McIntyre et al., 2009). Indeed, this system has been characterised by the marginalisation of family farming with low capital and land, the abolition of subsistence agriculture, the loss of cultural identity, knowledge, traditional agricultural practices, the decline of (agro)biodiversity, soil contamination, overuse of inputs, soil degradation, the intensification of climate change and the impact on consumer health, among other impacts (Tilman, 1999; Delgado Cabeza, 2010; García-Llorente et al., 2019).

Although there are many alternative approaches proposed by science, agroecology has been considered as a possible solution to the above-mentioned problems (Anderson et al., 2015; Gliessman 2015, Gliessman 2020). According to Altieri (1999), agroecology is understood as the application of ecological concepts and principles to the design and management of sustainable agroecosystems. In this way, several fields of knowledge have focused on understanding agroecology as a natural scientific discipline and have researched its contribution to the sustainability of agroecosystems (Altieri 2002; Kremen and Miles, 2012; Wezel et al., 2014; Altieri et al., 2015). Altieri (2002) remarked the role of agroecology as a natural science able to provide the scientific basis to combine diverse and productive agroecosystems by embracing and understanding their complex ecological structure and function. Its practical implementation has been proved to be more effective than conventional practices in conserving biodiversity and supplying a wide variety of ecosystem services. Examples of this are: a more efficient use of carbon substrates (Chavarria et al., 2018), the possibility of intercropping to provide pest and weed control (Francis, 1986); improvement of nitrogen content in soil by intercropping legumes (Malézieux et al., 2009); or climate regulation through the use of grass strips to increase soil organic carbon stock (Van Vooren et al., 2018).

Additionally to the understanding of agroecology as a natural scientific discipline that studies the productive system, Wezel et al. (2009) claim in their work that agroecology is also considered a set of principles and practices that promote the ecological, socio-economic and cultural resilience of agricultural systems and a social movement that seeks a different way of considering agriculture and its relation with society. According to Wezel et al. (2009), in the 1920s the agroecology

concept appeared as a scientific discipline combining agronomy and ecology. It was in the 1970s that its mainstream expansion took place. The term agroecology appeared for the first time in the scientific literature and it began to be considered not only as a discipline with theoretical approach, but also as a set of practices. During the 1980s, such agroecological practices were adopted by numerous social movements as an alternative to industrial agriculture (Sicili, 2014). As mentioned by Sourisseau et al. (2018), the different understandings of agroecology reflect the current debate on the future of agriculture in our society. Some definitions of agroecology are more technical and closer to the organic farming certification and the productive dimension. Meanwhile, others are more focused on the role of social movements, collective action and peasant-to-peasant knowledge (Markelova and Meinzen-Dick 2009; Altieri et al., 2012). Since different definitions of agroecology exist, Gallardo-López et al. (2018) have analysed how the concept has evolved over time, finding that agroecology is mainly considered as a science, as a practice and to a lesser degree as a social movement. Indeed, they suggest that a more equal relationship among these three components could boost the understanding of agroecology as an interdisciplinary concept. In this manuscript, we understand agroecology as a holistic concept that aims to contribute to the transition towards social-ecological sustainability. In this context, we embrace the wide definition provided by the Food and Agriculture Organization of the United Nations (FAO, 2018) which considers that to define agroecology accepting its holistic character (i.e., integrating ideas from various disciplines, understanding agroecology as a whole, going beyond the individual collection of parts), 10 elements must be taken into account: diversity, co-creation and sharing of knowledge, synergies, efficiency, recycling, resilience, human and social values, culture and food transitions, responsible governance and circular and solidarity economy. In this study, we aim to analyse the understanding of agroecology from the policy-influential stakeholders' perspective, as an essential stakeholder group for the recognition of agroecology at the policy level.

In this regard, within the recent past, agroecology has been gradually legitimised at a global level, being recognised by the FAO in 2018. The organisation created an initiative called Scaling up Agroecology, which highlights the relevance of agroecology, showing how it can be a key to meeting the Sustainable Development Goals (SDGs) set out in the 2030 agenda (FAO, 2018). The Scaling up Agroecology initiative focuses on broadening the political impact of agroecology, due to the lack of agroecological awareness among decision-makers and the absence of political and economic support when it comes to prioritising sustainable approaches.

In Spain, agroecology is on the path of being scientifically recognised. As a matter of fact, the Spanish Association of Terrestrial Ecology (AEET) has created an agroecology research network. There are also research lines, academic groups and high education options that are becoming relevant in the study and teaching of agroecology (Wezel et al., 2018; Acosta-Naranjo et al., 2019). Agroecology is also gaining

more support in the political sphere in Spain. In this sense, on November 20, 2018 a proposal concerning the application of agroecology to achieve the SDGs was presented in the Congress of Deputies (Boletín Oficial de las Cortes Generales, 2018). Additionally, in 2010 Red TERRAE (Network of Agroecological Reserve Territories) was born, a partnership of Spanish Municipalities involving different stakeholders to promote agricultural biodiversity and employment generation. However, the main principles of agroecology are not reflected in the public policies of the Community of Madrid, neither in the agrifood production system nor in the demands of consumers. Oteros-Rozas et al. (2019) state that the implementation of agroecological measures by public authorities is still at its early stage and should be encouraged. These same authors consider that agroecology is still an unknown concept in many influential areas (e.g. health, food, tourism, education).

In this context, the project 'AgroecologiCAM: Uncovering agroecology as a model of local farming and as a strategy for the design of local agrifood systems' was born. The project understands agroecology as a proposal of transition towards a more sustainable, healthy and fair agrarian model and agrifood system (<http://agroecologicam.org/>). The general objective of the AgroecologiCAM project is to address the barriers that are holding back the development of agroecology in the Madrid region. It is a three-year project (2018–2021) and it is implemented by an Operational Group (OG) promoted by the Rural Development Programme (RDP) of the Community of Madrid (2014–2020); Measure 16 of Cooperation (PDR Madrid, 2017). The OG AgroecologiCAM (2019) deals with the following three dimensions and goals: (1) knowledge, by extending the scientific and technical agroecological knowledge, (2) policy, by providing a space of dialogue and discussion to technicians, public administration managers and decision-makers to increase the institutional and social recognition of agroecology; and (3) dissemination, by making visible the role of the productive sector and raising consumers' awareness of agroecological products.

Within the AgroecologiCAM project, the general objective of this paper is to analyse the understanding and impact of agroecology in the Madrid region by involving technicians, managers, decision-makers, etc., identified as policy-influential stakeholders in the design, implementation or evaluation of policies. We refer to the term understanding of agroecology to analyse the meaning or conceptualisation of agroecology held by policy-influential stakeholders, since there is not a unified definition of agroecology and their view will determine their actions. The term impact of agroecology refers to the incidence agroecology has in the political agenda including related barriers and challenges as perceived by the attendees. To deal with this objective, we conducted the next two tasks: (1) assess the conceptualisation of agroecology and its association with environmental, economic, sociocultural and governance components of the agrarian model and the agrifood system; and (2) explore the perceptions regarding the main barriers and challenges for a greater impact of agroecology on the future political agenda. Hence, by our investigation we attempt to respond to the following

research questions in the context of the Madrid region: How do influential stakeholders understand agroecology? What do they know about agroecology and the different elements of the agroecosystems? What has still to be done to promote an agroecological transition in the Madrid region? This information is intended to better understand the meaning of agroecology for policy-influential stakeholders in the Madrid region, to later facilitate political support to design agroecological strategies that foster the future transition of the agrarian model and the agrifood system in the region.

2 Material and methods

2.1 Study area

The project is linked to the development and fostering of agroecology in the region of Madrid, which is administratively defined as the Community of Madrid, and especially in the rural territories of the region. The Madrid region occupies an area of 8028 km² with a population of 6.7 million of inhabitants (for 2019) distributed in 179 municipalities. Madrid city hosts almost half of its total population and, as other European capitals, its metropolitan power leads to a minority of rural areas and a modest territory dedicated to agricultural activities: 28% agricultural land and 7% pastureland (del Valle et al., 2018). Madrid rural areas are divided in three regions: north (19 municipalities), southwest (42 municipalities), and southeast (23 municipalities; Figure 1). For a good representation of stakeholders from a large diversity of rural territories we held three participatory workshops in three municipalities of each rural territory to encourage the attendance of representatives from the three rural areas. The fourth participatory workshop was held in the Gastronomic Innovation Center of Madrid city, in order to encourage the attendance

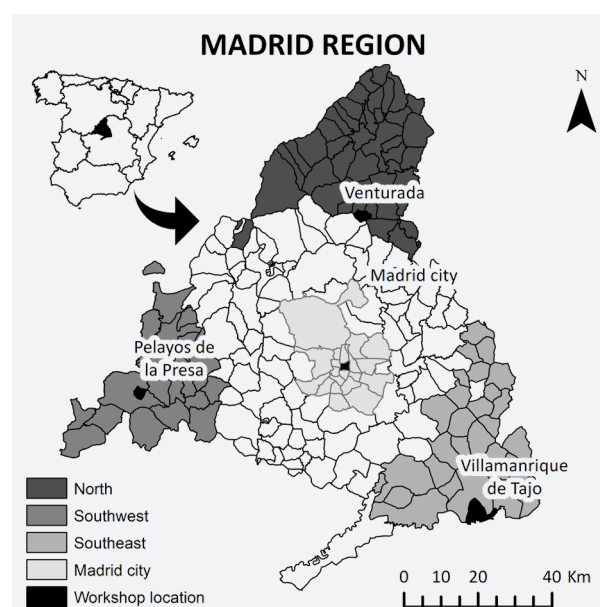


FIGURE 1 Rural municipalities of the Madrid region, classified by area (north, southwest and southeast) and location of the four participatory workshops, including Madrid city

of technicians, managers of the public administration and decision-makers who develop their professional activity in the headquarters in Madrid city, such as the Regional Government of the Environment, Territorial Planning and Sustainability.

2.2 Recruitment and characterisation of attendees

The sample was composed of technicians, managers, landscape planners, decision-makers, and other public staff from the local and regional government of the Madrid region related with the development of public food, rural, agricultural and landscape planning policies. In addition, the recruitment of attendees also considered other influential stakeholders from the academic, educational, and environmental sectors (Figure 2).

In order to advertise the event, we notified Madrid city councils by e-mail including an informative digital leaflet and posters containing relevant information of the participatory workshops. Announcements were also published on the websites of the project (agroecologicam.org), the Madrid City Council (madrid.org), the Community of Madrid (comunidad.madrid) and other web pages for the agroecological transition in Madrid such as agrolabmadrid.com, observatorioculturayterritorio.org, agroecologia.net, and tierrasagroecologicas.es. We also sent personal invitations to policy-influential contacts we already knew from the AgroecologiCAM project network. Additionally, we contacted the Local Action Groups of the three rural territories of the Community of Madrid who contributed to disseminate the call.

An important recruitment effort was done; nevertheless, some limitations regarding the open sample selection must be considered such as the over or infra representation of perspectives (Harrison, 2013). Since the participatory workshops were voluntary, we probably missed policy-influential

stakeholders with decision-making capacity in the development of public food rural, agricultural and landscape planning policies but without an interest, or even with reluctant positions, in agroecological approaches to reframe the conventional farming system. We assume that the people who finally took part in the workshops were the ones that decided freely to attend, and that were mostly interested in the topic, because of either their high knowledge or their interest to learn about it. This attendees' profile is the one that could best contribute and enhance the understanding of the phenomenon under study (Creswell, 2008). Further research could be enriched by combining the information extracted from the participatory workshops with personal interviews with the missing policy-influential stakeholders. Another potential bias of the open invitation is that the number of attendees is not predetermined. To tackle this shortcoming, a recommended but not compulsory pre-registration was done. In addition, four facilitators assisted each session, and a plan for working in break-out groups was designed. Finally, as in any participatory activity, there was a risk of experiencing power asymmetries in the deliberation process by the attendance of dominant attendees leading the discourse. To minimise this, the participatory workshops were moderated and speaking times were carefully given.

Overall, the participatory workshops were attended by 79 attendees (8 people in two of the rural municipalities, 32 in the third rural participatory workshop, and 31 people in the participatory workshop organised in Madrid city); of those, 42 responded the written questionnaire (7 people in the first rural municipality, 6 people in the second rural municipality, 11 people in the third rural municipality, and 18 people in the participatory workshop organised in Madrid city).

The respondents were 23 men and 19 women. Most of them were between 40 and 60 years old and 36 (85%) of them had received university education. Some similarities

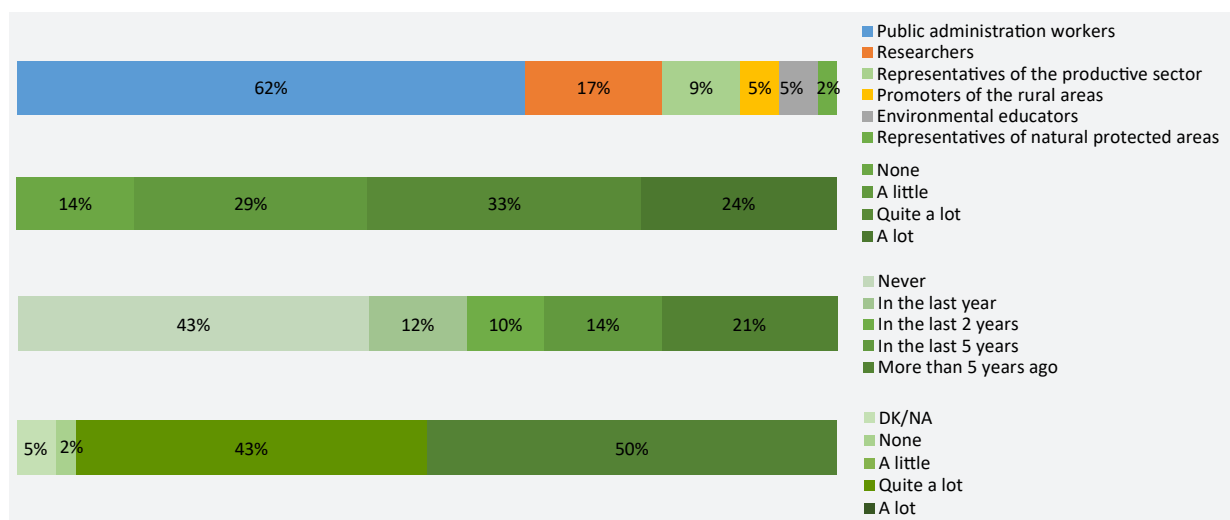


FIGURE 2 Characterisation of the respondents' profile (n=42): (A) professional role; (B) professional linkage to agroecology; (C) time since the concept was incorporated into their professional activity; and (D) level of importance of integrating agroecology into public policy design at different scales according to the respondents.

have been found with a study carried out by Migliorini et al. (2017) that assessed the perception, definition and future expectations of different stakeholders regarding agroecology and organic agriculture. In both cases, the public stands out for its knowledge and interest in agroecology (Figure 2). Although the participatory workshops were mainly focused on stakeholders from the public administration, researchers have shown their interest on agroecology with their participation (Figure 2: A). This fact can be explained by Wezel et al. (2018), who argue that research and education are currently major components of agroecology in Europe. In this paper, part of the researchers who attended the event were aware of it because of their link to the AgroecologiCAM project. Additionally, it is important to stress the fact that 24 (57 %) respondents have incorporated agroecology into their professional activity (19 (80 %) of them have been doing so for more than two years; Figure 2: B, C). With regard to their motivation to take part in the participatory workshops, the interest in agroecological practices for the development of rural municipalities was the dominant factor (9 respondents; 21 %); others participated because they considered important the promotion of agroecology (8 respondents; 19 %) or in order to incorporate it in their work (8 respondents; 19 %); 6 respondents (14 %) attended because they were interested; 3 respondents (7 %) participated with the objective of acquiring knowledge of effective agroecological practices and to form networks with different stakeholders; the same number of people (3 respondents; 7 %) participated because they were members of the AgroecologiCAM project; and the remaining 2 respondents (5 %) participated because they wanted to include agroecology in Environmental Education. Finally, the written questionnaire showed that 39 (93 %) of the respondents considered the integration of agroecology into public policies necessary (Figure 2: D).

2.3 Data collection

Data was collected in four participatory workshops held in the Madrid region through an attendant list, a questionnaire and from active debate during the participatory workshops. Participatory workshop is a consultative data collection method based on gathering primary and qualitative information provided by a group dynamic with selected stakeholders. The aim of this participatory workshops was to acquire information from the positions and discourses of the sample, but also to incentive social learning, sharing and co-creating knowledge among the group. Social learning has been recognised as a key feature for socioecological sustainability issues because it enhances understanding and promotes the creation of trustworthy relationships among stakeholders with different perspectives, interests and needs (Opdam et al., 2013; Karimi et al., 2015; García-Nieto et al., 2019). These workshops allowed us to bring together diverse knowledge holders to seek their opinions, extract their knowledge and identify and understand challenges and barriers to an agroecological transition in Madrid in collaborative and creative environments (Knapp et al. 2011).

At the beginning of each participatory workshop an attendant list was completed, including the organisation

where they conduct their work and professional role; this information was relevant to characterise their profiles. All the information was collected anonymously and confidentially. Then, before starting the participatory workshop, attendees were asked to complete a questionnaire in order to gather information about their understanding of agroecology. As it has been noted previously, the number of respondents (n=42), attendants who answer the questionnaire, did not coincide with the number of participants (n=79) due to different reasons: those who arrived late to the participatory workshop did not respond, as the questionnaire had to be answered before the discussions began, those linked to the project did not respond either, and some attendees did not want/remember to respond to the questionnaire.

The questionnaire gathered personal information as well as information about their professional role, linkage to agroecology, motivations to participate and their agroecological understanding (Table 1). Additionally, 28 elements were given to analyse its importance and its relationship with agroecology covering ecological, sociocultural, economic and governance aspects (Table 2). Ten of the elements came from a selection made by FAO (2018a) described as the ten elements of agroecology: (1) human and social values of equity, inclusion and justice; (2) recycling of nutrients, biomass and water; (3) diversity of species, genetic resources and practices; (4) exchange of knowledge among producers; (5) efficiency in the use of products and energy; (6) synergies or synchronisation of production practices; (7) capacity to adapt to extreme events; (8) responsible governance; (9) circular economy that reconnects production and consumption; (10) culture, heritage and agrifood traditions. The remaining eighteen are also shown in Table 2 and were selected in order to cover more aspects that characterise agroecology according to scientific documents on the discipline (Palomo-Campesino et al., 2018; Wezel et al., 2018). The selection of agroecological elements did not cover misleading elements, because the purpose of this section was to include elements which are, in fact, descriptors of agroecology. As agroecology is a complex and holistic concept, it has many different descriptors covering ecological, sociocultural, economic and governance aspects. Thus, we have investigated the conceptualisation that stakeholders with a strong influence on policy making have on these elements.

Finally, once the questionnaires were completed, the discussions of the participatory workshop were carried out consisting of the challenges of agroecology in five different areas: (1) productive systems and the opportunities of employment and maintenance of the rural environment; (2) mitigation and adaptation to climate change; (3) consumers' role and health; (4) institutions and public policies; and (5) strategies for the agroecological transition and the rural development of the Madrid region 2021-2027. Before the discussion of each topic, a presentation was made covering its theoretical aspects; afterwards, the attendees adopted the roles of analysts, with the aim of raising questions or reflections so that the key challenges linked to each of the subjects could be identified. This way, the attendees that had something to say participated one by one. Since the attendees were somehow linked to the

TABLE 1

Summary of questionnaire information: variables used, coding type and main attributes

Variables	Coding type	Attributes
Professional role	Nominal	Characterisation of the respondent's professional profile
Organisation	Nominal	Organisation in which the respondent works
Level of education	Ordinal	1, non-formal education; 2, with complete primary education; 3, with complete secondary education; 4, complete education; 5, professional education; 6, college degree
Age	Ordinal	Age of the respondent
Sex	Dichotomous	1, woman; 0, man
Prof linkage	Ordinal	Application of agroecology in the work routine (1, none; 2, a little; 3, quite a lot; 4, a lot)
Years agroecology	Ordinal	How recently has agroecology been incorporated into the work routine (0, never; 1, in the last year; 2, in the last two years; 3, in the last 5 years; 4, more than 5 years ago)
Motivation	Nominal	Motivation for taking part in the participatory workshop
Policies	Ordinal	Level of importance of integrating agroecology into public policy design (1, none; 2, a little bit; 3, quite a lot; 4, a lot)
Agroecological understanding	Dichotomous	Agroecological understanding before the participatory workshop (1, yes; 0, no)
Definition	Nominal	Definition of agroecology
Term importance (28 terms)	Ordinal	Level of importance of different terms (1, not important - 10 highly important)
Term relation (28 terms)	Ordinal	Relationship between different terms and agroecology (1, unrelated - 10 closely related)

agroecological development in the Madrid region, they were expected to identify local barriers and challenges of agroecology. Thereby, they could show their perspectives and give information about the situation of agroecology mainly in rural territories of the Madrid region.

The participatory workshops were facilitated by at least four people who introduced the AgroecologicAM project, explained the five topics, enabled the active participation, controlled times, recorded audios, and took notes. They were experts in topics such as agroecological development, circular economy in agrifood systems, climate change, rural development, etc.; with a track record as facilitators in agroecological development processes. The audio obtained from these participatory workshops was recorded in digital devices.

2.4 Data analysis

The data obtained from the questionnaires (n=42) was entered in Microsoft Excel- using the parameters mentioned in data collection section- and analysed with the XLSTAT extension. By means of this data, a detailed descriptive analysis was carried out to analyse the agroecological understanding of the respondents; then, a scatter diagram was created to study the relationship between the importance given to certain elements and the relationship with agroecology that the respondents considered these elements to have. Then, data was analysed with the non-parametric Kruskal-Wallis test (Kruskal and Wallis 1952) with the aim of evaluating whether there were significant differences between the scores given by the respondents and the various elements of the agrarian model and the agrifood system. A Dunn test (Dunn 1964) was then performed to identify the groups of elements that did not show significant differences between

them, with the objective of verifying the test performed previously and analysing which elements have similar patterns and from which ones they differ.

Finally, audio recordings of the participatory workshops discussions (n=79) were fully transcribed; interventions were firstly coded and secondly classified by topic and the resulting list was then exported to Atlas.ti, where the qualitative analysis was further conducted creating codes to be regrouped into families. Once the information was analysed, a diagram was created summarising the barriers and challenges of agroecology as perceived by those attending the participatory workshops.

3 Results

3.1 Agroecological knowledge and the relationship between agroecology and environmental, sociocultural, economic and governance elements of the agrarian model and the agrifood system

Overall, 36 respondents (86 %) already knew about the concept of agroecology before taking part in the participatory workshop. However, the conceptualisation of agroecology varies among them: 11 respondents (26 %) defined agroecology as a set of sustainable farming practices, 10 respondents (24 %) as a socially and environmentally sustainable production, 9 respondents (21 %) identified it as the application of ecology in agriculture, 5 respondents (12 %) considered it a holistic and multidisciplinary concept, and 2 respondents (5 %) defined agroecology as the necessary application of an urban-rural link.

TABLE 2

Importance of the 28 elements expressed by the respondents and the relationship the respondents considered these elements to have with agroecology (scoring levels from 1-not important/unrelated to 10-highly important/closely related). Arithmetic Mean, Standard Deviation and Dunn Groups are indicated.

Elements of Agroecology	Importance			Relationship with agroecology		
	Arithmetic mean	Standard deviation	Dunn groups*	Arithmetic mean	Standard deviation	Dunn groups*
Recycling of nutrients, biomass and water	9.54	1.05	c	9.68	0.75	b
Ecology and conservation of the environment	9.51	1.12	b-c	9.59	0.90	b
Circular economy that reconnects production and consumption	9.29	1.13	a-b-c	9.33	1.01	a-b
Efficiency in the use of products and energy	9.27	1.12	a-b-c	9.24	1.21	a-b
Human and social values of equity, inclusion and justice	9.25	1.30	a-b-c	9.00	1.72	b
Fertile and living soils	9.24	1.14	a-b-c	9.57	0.77	a-b
Healthy food	9.15	1.11	a-b-c	9.16	1.28	a-b
Rural development	9.15	1.12	a-b-c	9.11	1.31	a-b
Farm-to-table and short-circuit solutions	9.07	1.21	a-b-c	9.05	1.35	a-b
Environmentally sustainable consumption	9.02	1.24	a-b-c	9.08	1.30	a-b
Fresh and seasonal food	9.00	1.20	a-b-c	9.16	1.36	a-b
Organic farming	8.98	1.51	a-b-c	9.23	1.33	a-b
Maintenance of local varieties	8.98	1.25	a-b-c	9.22	1.25	a-b
Socially sustainable consumption	8.90	1.32	a-b-c	8.72	1.6	a-b
Multifunctional landscapes with productive, aesthetic, recreational, ecological value, etc.	8.74	1.25	a-b-c	8.94	1.24	a-b
Resiliency (capacity to adapt) to extreme events	8.71	1.44	a-b-c	8.75	1.54	a-b
Carbon fixation	8.70	1.51	a-b-c	8.77	1.52	a-b
Responsible governance	8.69	1.49	a-b-c	8.25	1.92	a-b
Culture, heritage and agrifood traditions	8.68	1.46	a-b-c	8.78	1.61	a-b
Collaboration between actors	8.63	1.61	a-b-c	8.73	1.33	a-b
Employment niche	8.63	1.48	a-b-c	8.54	1.88	a-b
Fight against rural depopulation	8.62	1.87	a-b-c	8.57	1.85	a-b
Diversity of species, genetic resources and practices	8.59	1.65	a-b-c	8.89	1.57	a-b
Food sovereignty	8.46	1.68	a-b-c	8.60	1.82	a-b
Synergies or synchronisation of production practices	8.41	1.26	a	8.58	1.20	a-b
Exchange of knowledge among producers	8.39	1.51	a-b	8.54	1.45	a-b
Citizen participation	8.19	1.52	a	7.89	1.91	a
Access to land	8.00	1.86	a	8.26	1.79	a-b

* Dunn Groups collect sets of variables that are not significantly different from each other.

The importance and relationship with agroecology varied depending on the 28 elements proposed (Table 2). After the Kruskal-Wallis analysis, significant differences were found in the importance attached to the different elements (Kruskal-Wallis, $K= 87.48$; $p\text{-value}<0.01$), and their relationship with agroecology (Kruskal-Wallis, $K= 83.36$; $p\text{-value}<0.01$). On the one hand, dealing with the importance given by the respondents, recycling of nutrients, biomass and water (9.54, from a scoring from 1 to 10) was the most important element, followed by ecology and conservation of the environment (9.51) and circular economy that reconnects production and consumption (9.29). The ones with lower values were exchange of knowledge among producers (8.39), citizen participation (8.19) and access to land (8.00). In this sense, the groupings carried out by means of the Dunn test revealed that there were no significant statistical differences between most elements (a-b-c). The only exception was recycling of nutrients, biomass and water (c), which obtained a higher importance than both the exchange of knowledge among producers (a-b) and the following three elements: synergies or synchronisation of productive practices (a), citizen participation (a) and access to land (a) (all of them were not significantly different from each other; however, they did obtain significantly lower scores than recycling of nutrients, biomass and water). Only these last three elements were significantly different from ecology and environmental conservation (b-c). On the other hand, dealing with the relationship that the 28 elements have with agroecology, the following high scored elements are highlighted: recycling of nutrients, biomass and water (9.68), ecology and conservation of the environment (9.59) and fertile and living soils (9.57). While the elements considered with the lowest relationship with agroecology were access to land (8.26), responsible governance (8.25) and citizen participation (7.89). Citizen participation obtained a statistically significant lower value than the rest of the elements, having these obtained significantly similar scores to each other.

3.3 Barriers and challenges of agroecology

During the participatory workshops a total of 101 mentions were classified in five groups by topic and period of time. The five groups were: (1) productive systems and the opportunities of employment and maintenance of the rural environment; (2) mitigation and adaptation to climate change; (3) consumers' role and health; (4) institutions and public policies; and (5) strategies for the agroecological transition and the rural development of the Madrid region 2021-2027 (Figure 3).

Regarding the role of agroecological practices from the point of view of the productive system and the opportunities of employment and maintenance of the rural environment ($f=19/101$ mentions; Figure 3), the attendees remarked the absence of generational replacement and the lack of communication between producers, the economic low profitability of the sector due to lower yield, the insufficient employment generation and the loss of traditional values.

The challenges perceived in relation to the role of consumers for the agroecological transition were especially present during the participatory workshops ($f=27/101$ mentions;

Figure 3). In fact, the attendees made numerous interventions regarding logistical aspects related to the need to develop information strategies to promote socially and environmentally responsible consumption, the need to change the prevailing consumption habits characterised by high fast food consumption and by the demand of more products from abroad, the risk of reproducing an agrifood system that only some privilege groups of people could afford, and the need to better connect food consumption with health. Even if the role of agroecology in dealing with climate change was the least-mentioned topic ($f=10/101$ mentions; Figure 3), attendees mentioned barriers such as the lack of scientific evidence or the insufficient climate change awareness.

Several challenges were stated about institutions and public policies in the agroecological context ($f=24/101$ mentions; Figure 3). Indeed, attendees highlighted the lack of action of organizations and policies such as the World Health Organization (WHO), the Common Agricultural Policy (CAP), the Madrid Institute for Research and Rural, Agricultural and Food Development (IMIDRA), the Ministry of Ecological Transition, the state, autonomous and municipal Spanish governments. Other aspects stated regarding the role of institutions and public policies were the scarce number of competences of local governments, or the absence of citizen participation

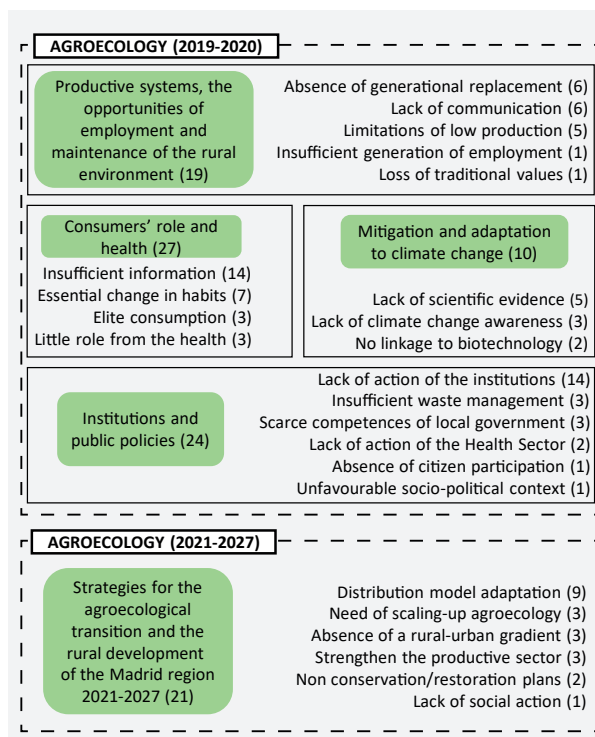


FIGURE 3

Barriers and challenges of agroecology perceived by the attendees ($n=79$) during the participatory workshops. Mentions have been classified into several themes, regrouped under five topics (green shaded) and divided in accordance with the period of time (2019/2020 and next programme period for the design of agrifood policies 2021-2027). The number of mentions is shown in parentheses.

in public policies, between others. Finally, the attendees identified some barriers that the agroecological transition could face in the future context of Madrid region ($f=21/101$ mentions; *Figure 3*), such as the need to adapt the distribution model by shortening the food supply chains, the need to scale-up agroecology, the need to promote an agroecological transition connecting urban-rural regions in Madrid, or the importance of consolidating the productive sector.

4 Discussion

A great majority of respondents already knew about the concept of agroecology before taking part in the participatory workshop. This result was expected, since the selected attendees were linked mainly to the policy-making sector (including public food, rural, agriculture and landscape planning policies) and, to the academic, educational, and environmental sectors.

Although the conceptualisation of agroecology varies among the respondents, all the definitions were complementary and emphasised different aspects of agroecology. Wezel et al. (2009) consider that the different interpretations of the concept depend on the set of contextual factors surrounding the individual. In this sense, Méndez et al. (2015) argue that by assuming the complexity of the term agroecology, the application of limited definitions is promoted, removing the interdisciplinary nature that characterises it.

Concerning the 28 environmental, sociocultural, economic and governance elements of the agrarian model and the agrifood system, it should be noted that the highest values were assigned to environmental elements while the lowest values were assigned to sociocultural (e.g. exchange of knowledge among producers) and governance (citizen participation, access to land) elements. This coincides with the systematic review conducted by Palomo-Campesino et al. (2018) in which it is shown that there are many more studies from natural scientific discipline than those that study sociocultural, economic or governance dimensions. One explanation that has contributed to this result is that the profile of the attendees was mainly linked to natural science disciplines such as Agronomy, Biology, Forestry or Environmental Sciences. This is reflected in the lower score of elements such as citizen participation or access to land, while both terms are considered by the academic world as essential points for a sustainable social, environmental and economic transition. For example, Altieri (2009) and Rossett et al. (2019), when describing La Via Campesina, highlight the involvement of this movement in the struggle for an agrarian reform that gives communities access and control over their land, in order to fulfil their demands. Likewise, it has been seen that agroecology is one of the possible ways to promote the development of rural areas and to deal with the problem of depopulation in rural Spain. On this matter, the Spanish Ministry of Territorial Policy and Public Function (2019) holds that the support for family farming is an essential measure to tackle rural depopulation, due to both its link with the territory and the fair distribution of wealth and employment it generates. For the reasons mentioned above, and

since the attendees mainly came from rural municipalities, a high score was expected in elements such as rural development, fight against rural depopulation, or employment niche. Although it is true that they received high values, these were not among the highest rated elements.

Regarding the agroecological challenges associated to the productive side, it is worth mentioning the difficulty and precariousness of working in the field, as well as the need to dignify the producers' profession. The FAO (2018) considers a duty of agroecology to place the producers at the centre of the agrifood system, emphasising dignity, equity, inclusion and justice. This shift should be immediate, since there are alarming statistics that show the reduction of farmers in Spain in favour of other economic sectors or moving towards larger cities (Franco and Borrás, 2013; Pinilla and Sáez, 2017; Acosta-Naranjo et al., 2019). The loss of traditional values and rural culture was highlighted as a threat by the attendees. Therefore, one of the points proposed by the FAO (2018) for the fulfilment of the SDGs through agroecology is to value the food heritage and local culture, promoting food security and at the same time respecting the ecosystems. At present, during the COVID-19 pandemic and health crisis, the need emerges to rethink the agrifood system and its vital role to feed the population in a healthy and sustainable way, promoting small-scale agroecological production (Gliessman, 2020). Another aspect mentioned by attendees was the lower productivity of agroecological plots. Despite this, the economic profitability of agroecological production has been proven, and there are studies that show the economic benefits provided by livestock and agricultural production through direct sales, agroecological canteens, or consumer groups (del Valle et al., 2018; Van der Ploeg et al., 2019). According to some attendees, the problem might arise from the lack of communication with the productive sector, since most small producers are unaware of these data. Indeed, Lucas and Gasselin (2018) investigate the "silent development" of agroecology, which is barely visible to conventional producers. Innovative agri-environment measures should be designed to focus on strengthening the economic viability and collaboration between the productive sector using agroecological practices either through collective approaches, support networks and other incentives from public or private sectors (Yacamán et al., 2020).

The data collected during the active participation and discussion at the participatory workshops demonstrated the vital role of consumers in demanding agroecological products. Indeed, Levidow et al. (2014) consider that the role of research is key to strengthening consumer support for agroecological production. In the same study, the authors mention the advantages of considering the opinions and tastes of consumers in order to create and increase agroecological knowledge, as well as the need to encourage consumer support for small food producers who are not certified. At the same time, the possibility of reaching this change in consumption habits through health should be considered, with the use of fresh, seasonal products and free of harmful substances. The FAO (2018) holds that the new markets that trade agroecological products represent an attempt to

respond to the growing demand for healthier diets. Horrigan et al. (2002) consider that raising awareness about the serious health impacts of conventional agriculture is essential both in the short and long term (e.g. cardiovascular diseases, cancer risk, bioaccumulation of toxic substances in the body, etc.). Finally, attendees referred to the high price of agroecological products, since it can make agroecology unfeasible on a large scale due to its elitism of consumption (Figure 3). Concerning the link between agroecology and nutrition, Poux and Aubert (2018) have demonstrated that the implementation of widespread agroecological farming practices by 2050 could boost the adoption of healthier diets (e.g. reduction in meat consumption, or higher fibres intake) by European citizens.

The impact of agroecology as a tool for mitigation and adaptation to climate change was not particularly noticeable, but it was also considered. Scarborough et al. (2014) compare various diets in terms of greenhouse gas (GHG) emissions and found a huge difference, almost three times greater, between meat and vegetable-based diets. In addition, it is important to take into consideration the contribution of agroecological production in terms of carbon fixation, nutrient recycling and reduction of GHG emissions due to the proximity of consumption. Moreover, Altieri (2009) highlights the capacity of traditional agricultural systems to naturally increase productivity and resilience to changing climatic conditions. As argued by the FAO (2018), it is claimed that there is a need to expand scientific research on agroecology in order to gain evidence of its positive effects, thus creating a consolidated theoretical basis for the development of public policies.

The challenges perceived in relation to the role of institutions and public policies were numerous. Many organisations were mentioned for their inaction in agroecological issues, although they are essential for the promotion of agroecology (Oteros-Rozas et al., 2019). In this regard, one of the debates of the participatory workshops covered the possibility of learning from the French model, on which the CAP is based and that has already been implemented in the country through the Law d'Avenir (Law No. 2014-1170, 2014) "for the future of agriculture, food and forestry". The Law d'Avenir proposed a new agricultural model by combining economic, social and environmental considerations under an agroecological policy in which farmers' groups are considered (Bodiguel, 2014). It is claimed that one of the limitations of the law is the difficulty in developing indicators and evaluating tools to measure the reality of its implementation due to the diversity of definitions, practices and approaches that characterise agroecology (Claveirole, 2016). Similarly, some attendees stressed that the current socio-political context is not very favourable for the development of agroecology, due to the overall political and economic regime, and the inability of the local authorities to act due to their lack of competences. However, it was highlighted that various local government competencies, duties and responsibilities, can be used for the introduction of agroecological measures at the local level: parks and gardens, which can lead to the creation of urban homegardens; waste collection and management, where agro-composting initiatives can be created; consumption, markets and trade, such as the promotion of agroecological markets or healthy

consumption campaigns; and culture, through the creation of agroecological training and leisure activities (Begiristain-Zubillaga, 2018; López-García et al., 2018; Cevallos-Suarez et al., 2019).

Overall, the attendees mentioned several aspects that should be considered by policy makers in order to promote the agroecological transition in the Madrid region; being the adaptation of the distribution model essential. There is a need of reforming the prevailing distribution model towards short food supply chains are required, from both a legislative and a logistic point of view. As Yacamán et al. (2020) state, knowledge, communication and public policies are key elements to boost the agroecological transition in Madrid. In relation to this and considering the important role given to consumers during the participatory workshops, the regional government must develop awareness-raising campaigns accompanied by the promotion of Madrid agrifood production in order to gain consumers' support in the agroecological market. By implementing these strategies, local agroecological production can take advantage of the proximity to the large food demand by the Madrid city. This implies establishing reliable producer-consumer connections. Likewise, Nicholls et al. (2016) highlights the importance of developing equal opportunities among producers based on networks, emphasising the creation of marketing and distribution schemes. Another aspect that must be considered by policy makers is the need to structure and reorganise marketing and distribution channels. These can be tackled through the creation of markets dedicated solely to the sale of organic products or by the development of platforms to join producers and consumers together (Germinando, 2019). To this end, Levidow et al. (2014) claim that numerous initiatives have already been implemented in Europe in order to bring producers and consumers closer together with the aim of creating agrifood networks and proximity trade. Finally, Mier et al. (2018) identified eight aspects that foster the scaling of agroecology, being mobilisation of discourse and the promotion of favourable public policies relevant components. In this research, we would like to take a first step forward towards the institutionalisation of agroecology in Madrid region by the establishment of a space of dialogue with policy-influential stakeholders in the design of agroecological policies.

5 Conclusions

The sample of this study – policy-influential stakeholders – shows a clear interest in and understanding of agroecological issues. The data obtained indicates the diversity of meanings of agroecology and the complexity of defining it (Wezel et al., 2009; Méndez et al., 2015). The agroecological knowledge has been predominantly associated with the environmental elements of agroecosystems (recycling of nutrients, biomass and water; and ecology and conservation of the environment) as opposed to the sociocultural, economic and governance components affecting the whole agrifood system. Despite the potential difficulties of not having a unified definition; it is important to embrace the plurality of the concept;

considering all its dimensions and its applicability in the whole agrifood system.

Regarding the barriers and challenges to an agroecological transition in the Madrid region, following our findings, from the productive side, it is essential to develop a variety of networks for the transmission of agroecological knowledge (Nicholls et al., 2016) and to understand the needs of the productive sector. Additionally, future strategies must focus on the demand side of consumers, which is deemed as an essential factor in fostering agroecological production (Levidow et al., 2014). This could be accomplished by analysing the public information promoting healthy and socio-environmentally sustainable modes of consumption and by strengthening the connexion between the productive sector and local consumers. In terms of the policy perspective, we highlight the absence of a legal framework in agroecology. The institutionalisation of agroecology, together with the implementation of public policies is a decisive factor for an agroecological transition. As Mier et al. (2018) remarked, the mobilisation of discourse and the promotion of favourable public policies are drivers to encourage the scaling up of agroecology; together with other aspects such as the moments of crisis, that foster the search of alternatives. Under the global change context and the health, economic and environmental crisis we are facing, it is time to support agroecological transitions. To do so, a coordination between the different levels of the public administration and the academic and the productive sectors is essential.

Acknowledgements

We sincerely thank all the people who attended the participatory workshops devoting their time, efforts and reflections towards the future of sustainable farming in the Madrid region. Our thanks also go to the AgroecologiCAM members for their assistance and contribution in the dissemination of the participatory workshops. We want to express our gratitude to all those workers who despite the outbreak of the COVID-19 are keeping the agricultural sector well-functioning. This study received funding from: (1) AgroecologiCAM project funded by the European Union, the Spanish Ministry of Agriculture, Food and the Environment and Madrid Regional Government under the Rural Development Programme (RDP-CM 2014-2020), (2) from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 81819, by the project entitled: Co-design of novel contract models for innovative agri-environmental-climate measures and for valorisation of environmental public goods, and from (3) SAVIA-Sowing Alternatives for Agroecological Innovation project funded by a call for R&D projects for young researchers from the Autonomous University of Madrid-Comunidad de Madrid (SI1/PJI/2019-00444).

REFERENCES

Acosta-Naranjo R, Amores-Lemus L, de España-Rigo AS (2019) ¿Agroecología en la España despoblada? Cuaderno de Investigación Urbanística 124:44–58

- Altieri MA (1999) The ecological role of biodiversity in agroecosystems. *Agr Ecosyst Environ* 74(1-3):19–31, doi:10.1016/S0167-8809(99)00028-6
- Altieri MA (2002) Agroecología: principios y estrategias para diseñar sistemas agrarios sustentables. In: Sarandon SJ (ed) *Agroecología: el camino hacia una agricultura sustentable*. Buenos Aires–La Plata, 49–56
- Altieri, MA (2009) Agroecology, small farms, and food sovereignty. *Monthly Review* 61(3):102, doi:10.14452/MR-061-03-2009-07_8
- Altieri MA, Funes-Monzote FR, Petersen P (2012) Agroecologically efficient agricultural systems for smallholder farmers: contributions to food sovereignty. *Agron Sustain Dev* 32(1):1–13, doi:10.1007/s13593-011-0065-6
- Altieri MA, Nicholls CI, Henao A, Lana, MA (2015) Agroecology and the design of climate change-resilient farming systems. *Agron Sustain Dev* 35(3):869–890, doi:10.1007/s13593-015-0285-2
- Anderson C, Pimbert M, Kiss C (2015) Building, defending and strengthening agroecology. A global struggle. ILEIA - Centre for learning on sustainable agriculture, the Netherlands.
- Begiristain-Zubillaga M (2018) Comercialización agroecológica: un sistema de indicadores para transitar hacia la soberanía alimentaria. Cuadernos de trabajo 75. Hegoa, Instituto de Estudios sobre Desarrollo y Cooperación Internacional. Universidad del País Vasco, 51 p
- Bodiguel L (2014) Quand le droit agro-environnemental tranvennde le droit rural - Réflexions suite à la loi d'Avenir pour l'agriculture, l'alimentation et la forêt de 2014. *Revue de Droit Rural, Editions techniques et économiques / LexisNexis*
- Boletín Oficial de las Cortes Generales (2018) Boletín Oficial de las Cortes Generales: Congreso de los Diputados, XII legislatura. Num. 454:57–58
- Borlaug, NE (1971) The green revolution: For bread and peace. *B Atom Sci* 27(6): 6–48, doi:10.1080/00963402.1971.11455372
- Cevallos-Suárez M, Urdaneta-Ortega F, Jaimes E (2019) Desarrollo de sistemas de producción agroecológica: Dimensiones e indicadores para su estudio. *Rev Cienc Soc* 25(3):172–185
- Chavarría DN, Pérez-Brandan C, Serri DL, Meriles JM, Restovich SB, Andriulo AE, Jacquelin L, Vargas-Gil, S (2018) Response of soil microbial communities to agroecological versus conventional systems of extensive agriculture. *Agr Ecosyst Environ* 264:1–8, doi:10.1016/j.agee.2018.05.008
- Claveirole C (2016) La transition agroécologique: défis et enjeux. Paris, les éditions des Journaux officiels
- Creswell JW (2008) Educational research: planning, conducting, and evaluating quantitative and qualitative research. Pearson International Edition
- Delgado Cabeza M (2010) El sistema agroalimentario globalizado: Imperios alimentarios y degradación social y ecológica. *Economía Crítica* 10:32–61
- del Valle J, Jiménez L, Morán N, Clemente R., Medina Á (2018) La producción agroecológica en la Comunidad de Madrid. Radiografía del presente y una mirada hacia el futuro. Iniciativas Socioambientales Germinando
- Dunn OJ (1964) Multiple comparisons using rank sums. *Technometrics* 6:241–252
- European Commission (2015) The European Agricultural Fund for Rural Development: Rural development priorities 2014-2020. Publications Office, doi:10.2762/94317
- FAO (2018) Scaling up agroecology initiative – Transforming food and agricultural systems in support of the SDGs. A proposal prepared for the International Symposium on Agroecology, 3-5 April 2018, 17 p
- Francis CA (1986) Multiple cropping systems. New York: Macmillan, 383 p
- Franco J, Borrás Jr S (2013) Land concentration, land grabbing and people's struggles in Europe. Transnational Institute for European Coordination Via Campesina and Hands off the Land Network
- Gallardo-López F, Hernández-Chontal M, Cisneros-Saguilán P, Linares-Gabriel A (2018) Development of the Concept of Agroecology in Europe: A Review. *Sustainability* 10(4):1210, doi:10.3390/su10041210
- García-Llorente M, Astier AC, Clemente-Pereiro R, Hernández-Jiménez V, Palomo S, Redondo-Arandilla M, Martín M, Benito A (2020) Contribución del Grupo Operativo AgroecologiCAM al desarrollo de políticas agroecológicas de la Comunidad de Madrid. In: Simón X, Pérez-Neira D, Copena D (Coord.) VII Congreso de Agroecología Políticas alimentarias para a Sustentabilidade, 167–177
- García-Llorente M, Pérez-Ramírez I, de la Portilla CS, Haro C, Benito A (2019) Agroecological strategies for reactivating the agrarian sector: The case of Agrolab in Madrid. *Sustainability* 11(4):1181, doi:10.3390/su11041181
- García-Nieto AP, Huland E, Quintas-Soriano C, Iniesta-Arandia I, García-Llorente M, Palomo I, Martín-López B (2019) Evaluating social learning

- in participatory mapping of ecosystem services. *Ecosystems and People* 15(1):257–268, doi: 10.1080/26395916.2019.1667875
- Germinando (2019) Políticas Públicas y Agroecología en la Comunidad de Madrid. Informe 1: Pensando el PDR desde una Perspectiva Agroecológica, 58 p
- Gliessman S (2020) Transforming food and agriculture systems with agroecology. *Agr Hum Values* 37:547-548.
- Gliessman S (2015) Agroecology: A Growing Field. *Agroecol Sust Food* 39(1):1–2, doi:10.1080/21683565.2014.965869
- Harrison S (2013) The problem of sampling in qualitative research. *Asian Journal of Management Sciences and Education* 2(2):202-210.
- Horrigan L, Lawrence R, Walker P (2002) How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environ Health Persp* 110(5):445–456, doi:10.1289/ehp.02110445
- Karimi A, Brown G, Hockings M (2015) Methods and participatory approaches for identifying social-ecological hotspots. *Appl Geogr* 63:9–20, doi:10.1016/j.apgeog.2015.06.003
- Knapp C N, Fernández-Giménez M, Kachergis E, Rudeen A (2011) Using participatory workshops to integrate state and transition models created with local knowledge and ecological data. *Rangeland Ecol Manag* 64(2):158-170, doi:10.2307/25835917
- Kremen C, Miles A (2012) Ecosystem services in biologically diversified versus conventional farming systems: benefits, externalities, and trade-offs. *Ecol Soc* 17(4), doi:10.5751/ES-05035-170440
- Kruskal WH, Wallis WA (1952) Use of ranks in one-criterion variance analysis. *J Am Stat Assoc* 47(260):583–621
- Law No. 2014-1170 (2014) La loi d'avenir pour l'agriculture, l'alimentation et la forêt, 2014-1170.
- Levidow L, Pimbert M, Vanloqueren G (2014) Agroecological research: Conforming – or transforming the dominant agro-food regime? *Agroecol Sust Food* 38(10): 1127–1155, doi:10.1080/21683565.2014.951459
- López-García D, Pomar-León A, García-Gacía V, Tendero-Acín G, Sampedro Y, Sastre-Morató AN (2018) Contradicciones en los saltos de escala. Procesos participativos y planes de acción para la transición agroecológica en la escala metropolitana. *Agroecología* 13(1):33–43
- Lucas V, Gasselin P (2018) Une agroécologie silencieuse: Ombres et lumières dans le champ professionnel français. 12èmes journées de recherche en sciences sociales INRA-SFER-CIRAD 13–14
- Nicholls CI, Altieri MA, Vazquez L (2016) Agroecology: Principles for the Conversion and Redesign of Farming Systems. *J Ecosys Ecograph* 55:010. doi:10.4172/2157-7625.S5-010
- Malézieux E, Crozat Y, Dupraz C, Laurans M, Makowski D, Ozier-Lafontaine H, Rapidel B, de Tourdonnet S, Valantin-Morison, M (2009) Mixing plant species in cropping systems: concepts, tools and models: a review. *Agron Sustain Dev* 29(1):43–62, doi:10.1051/agro:2007057
- Markelova H, Meinzen-Dick R (2009) Collective action for smallholder market access. CAPRI, CGIAR Systemwide Program on Collective Action and Property Rights. Policy Brief 6:1-4
- McIntyre BD, Herren HR, Wakhungu J, Watson RT (2009) Agriculture at a crossroads. International assessment of agricultural knowledge, science and technology for development (IAASTD) Global Report. Synthesis Report. Washington DC: Island Press, 590 p
- Méndez VE, Bacon CM, Cohen R, Gliessman SR (2015) Agroecology as a transdisciplinary, participatory, and action-oriented approach. Florida: CRC Press, 284 p
- Mier M, Cacho TG, Giraldo OF, Aldasoro M, Morales H, Ferguson BG, Rosset P, Khadse A, Campos C (2018) Bringing agroecology to scale: key drivers and emblematic cases. *Agroecol Sust Food*, 42(6) 637-665, doi:10.1080/21683565.2018.1443313
- Migliorini P, Lazzaro M, Bàrberi P, Ciaccia C, Colombo L, Canali S (2017) Convergences, divergence and specificities between Agroecology and Organic Agriculture in Italy. First Agroecology Europe Forum – Session 2 Co-evolution of organic agriculture and agroecology
- Opdam P, Nassauer JI, Wang Z, Albert C, Bentrup G, Castella JC, McAlpine C, Liu J, Sheppard S, Swaffield S (2013) Science for action at the local landscape scale. *Landscape Ecol* 28(8):1439–1445, doi:10.1007/s10980-013-9925-6
- Oteros-Rozas E, Ravera F, García-Llorente M (2019) How does agroecology contribute to the transitions towards social-ecological. *Sustainability* 11(6):1–13, doi: 10.3390/su11164372
- Palomo-Campesino S, González J, García-Llorente M (2018) Exploring the connections between agroecological practices and ecosystem services: A systematic literature review. *Sustainability* 10(12):4339, doi:10.3390/su10124339
- PDR Madrid (2017) Spain – Rural Development Programme (Regional), Comunidad de Madrid. The European Agricultural Fund for Rural Development: Europe investigating in rural areas
- Pinilla V, Sáez LA (2017) La despoblación rural en España: génesis de un problema y políticas innovadoras. *Informes CEDDAR*, 2
- Poux X, Aubert PM (2018) An agroecological Europe in 2050: multifunctional agriculture for healthy eating. Findings from the Ten Years For Agroecology (TYFA) modelling exercise, Iddri-ASCa
- Rosset P, Val V, Pinheiro Barbosa L, McCune N (2019) Agroecology and La Via Campesina II. Peasant agroecology schools and the formation of a socio-historical and political subject. *Agroecology and Sustainable Food Systems* 43(7-8):895–914, doi:10.1080/21683565.2019.1617222
- Scarborough P, Appleby PN, Mizdrak A, Briggs AD, Travis RC, Bradbury KE, Key TJ (2014). Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK. *Climatic Change* 125(2):179–192, doi:10.1007/s10584-014-1169-1
- Silici L (2014) Agroecology. What it is and what it has to offer. In food and agriculture. IIED, Issue Paper
- Sourisseau JM, Bélières JF, Marzin J, Salgado P, Maraun F (2019) The drivers of agroecology in sub-Saharan Africa: an illustration from the Malagasy Highlands. In: Côte FX, Poirier-Magona E, Perret S, Roudier P, Bruno R, Thirion MC (eds) The agroecological transition of agricultural systems in the Global South. Versailles: Éditions Quae, 179–197
- Spanish Ministry of Territorial Policy and Public Function (2019) Ministerio de Política Territorial y Función Pública Directrices Generales de la Estrategia Nacional frente al Reto Demográfico. Comisionado del Gobierno frente al Reto Demográfico, 100 p
- Tilman D (1999) Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices. *P Natl Acad Sci USA* 96(11):5995–6000, doi:10.1073/pnas.96.11.5995
- Van der Ploeg JD et al. (2019) The economic potential of agroecology: Empirical evidence from Europe. *J Rural Stud* 71:46–61, doi:10.1016/j.jrurstud.2019.09.003
- Van Vooren L, Reubens B, Ampoorter E, Broekx S, Pardon P, Van Waes C, Verheyen K (2018) Monitoring the impact of hedgerows and grass strips on the performance of multiple ecosystem service indicators. *Environ Manage* 62(2):241–259, doi:10.1007/s00267-018-1043-4
- Wezel A, Bellon S, Doré T, Francis C, Vallod D, David C (2009) Agroecology as a science, a movement and a practice. A review. *Agron Sustain Dev* 29(4):503–515, doi:10.1051/agro/2009004
- Wezel A, Casagrande M, Celette F, Vian JF, Ferrer A, Peigné J (2014) Agroecological practices for sustainable agriculture. A review. *Agron Sustain Dev* 34(1):1–20, doi:10.1007/s13593-013-0180-7
- Wezel A, Goette J, Lagneaux E, Passuello G, Reisman E, Rodier C, Turpin G (2018) Agroecology in Europe: Research, education, collective action networks, and alternative food systems. *Sustainability* 10(4):1214, doi: 10.3390/su10041214
- Yacamán C, García-Llorente M, Gutiérrez-Briceño I, Fernández M, Benito A (2020) Co-Diseño de soluciones contractuales innovadoras orientadas a potenciar la producción agroecológica y la conservación de bienes públicos ambientales. VIII Congreso Internacional de Agroecología. Universidad de Vigo. 1, 2 y 3 de julio 2020

OPEN ACCESS

This article is licensed under a Creative Commons Attribution 4.0 International License (<https://creativecommons.org/licenses/by/4.0/>)

© The author(s) 2020