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Agroecological Transitions: A Systematic Review of Research Approaches and Prospects for Participatory Action Methods

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There have been many calls for an agroecological transition to respond to food shocks and crises stemming from conventional food systems. Participatory action research and transformative epistemologies, where communities are research actors rather than objects, have been proposed as a way to enhance this transition. However, despite numerous case studies, there is presently no overview of how participatory approaches contribute to agroecological transitions. The present article therefore aims to understand the effect of applying participatory action research (PAR) in agroecology. We undertook a systematic review of articles reporting methods and results from case studies in agroecological research. On the one hand, our systematic review of 347 articles shows that the agroecological research scope is broad, with all three types—as science, a set of practices and social movement—well-represented in the corpus. However, we can see a clear focus on agroecology "as a set of practices" as the primary type of use of the concept. On the other hand, we found a few case studies (23) with a participatory approach while most studies used extractive research methods. These studies show that understanding the drivers and obstacles for achieving an agroecological transition requires long-term research and trust between researchers and farmers. Such transformative epistemologies open doors to new questions on designing long-term PAR research in agroecology when confronted with a short-term project-based society.

Keywords: systematic review, participatory action research, agroecology, transition, epistemic perspective

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INTRODUCTION

For some decades, agroecology has been presented as a reliable alternative to conventional agriculture, even though the definitions vary significantly (Stassart et al., 2012). Agroecology is often seen as either a relatively standardized biophysical climate-soil-landscape framework that may benefit long-term agricultural production (FAO., 1996; Fischer et al., 2005) or a much broader

approach to achieving sustainable food systems through ecological principles (Altieri, 1989; Francis et al., 2003; Gliessman, 2015). In other words, the term agroecology, which appeared primarily as a natural science field at the start of the 20th century, had its scope widened. Wezel et al. (2009) advocated that agroecology comprises three interlinked and complementary approaches: agroecology "as a scientific discipline," "as a set of practices," and "as a movement."

Thus, the scale at which agroecology was being studied broadened from plots and fields to food systems and regimes, the latter intertwined with food sovereignty movements (Wezel and Jauneau, 2011; McMichael, 2014). More recently, the debate has centered on the politics of the agroecological transition and food system transformation versus agricultural conformism (Rosset and Altieri, 2017; Giraldo and Rosset, 2018). Indeed, food is at the center of social-political stability, and agroecology might provide resilience toward food shocks and crises (De Schutter, 2010; De Schutter and Vanloqueren, 2011; Pimbert, 2017; Rosset and Altieri, 2017).

Henceforth, research and discussion on agroecology have been enriched by questioning its scalability. Although several works have demonstrated the potential of agroecology as "truly sustainable" (Altieri and Nicholls, 2005; De Schutter, 2010; HLPE., 2019, Chapter 1), agroecology has still been to a lesser extent integrated into current agricultural public policy agendas (Migliorini and Wezel, 2017). Non-government organizations (NGOs) and academics promote agroecology in various international arenas such as FAO's Agroecological hub and the Scientific Society of Agroecology (SOCLA), but according to La Vía Campesina. (2018) efforts to develop public policies supporting peasant agroecology are still scarce. For this reason, some organizations and academics demand a radical change in the food research agenda and project funding: democratizing the research and steering agricultural extension funds to agroecological programs must be the foremost strategy to achieve the agroecological transition (Fernández, 2006; Pimbert, 2017; Barling et al., 2018).

To some extent, the FAO and the European Union have included aspects of agroecology in recent official agendas (European Union., 2017; FAO., 2018a). However, while there is some level of support for disseminating and scaling up agroecology at the country level, there is no consensus on achieving it. For example, within their distinct socio-historical contexts, several Latin American countries have dealt with agroecology at the policy level in various ways based on their visions of what constitutes (or not) agroecology (Sabourin et al., 2017). On the one hand, some call for the complete transformation of food systems, coined by the term "transformative agroecology." On the other hand, some call for a "conformist agroecology," which includes a portfolio of practices that congregate with other concepts, such as conservation agriculture and climate-smart agriculture (Pimbert, 2017; Giraldo and Rosset, 2018). Giraldo and Rosset (2018) mentioned that agroecology's multiple dimensions and definitions are the root causes of these divergences.

Agroecological approaches to food systems explain the dichotomy between transformative and conformist agroecology (**Table 1**). Conformist agroecology emphasizes the food security rationale and proposes agroecological practices as an add-on to the portfolio of "sustainable" practices, such as climate-smart agriculture or "ecological" intensification. From another perspective, transformative agroecology focuses not only on food sovereignty but also on food and nutrition security and promotes agroecology as an interconnection between science, practice, and social movements. In other words, agroecology is not solely a set of sustainable practices but a merging of approaches (science, practices, and movements) to achieve sustainable, equitable, and just food systems, while respecting ecological principles. Thereby, research on transformative agroecology would involve anthropological methods (e.g., to assess local knowledge, practices, and cultural values, and identify community priorities as part of bottom-up approaches), alongside the application of multiple scientific disciplines that encourage interdisciplinary methodologies.

Transformative agroecology requires a fundamental shift in knowledge production. Hence, researchers in agroecology should reorient methods supporting research results constructed through specific social contexts (Levidow et al., 2014). Such a positional shift means the inclusion of methodologies that promote the active participation of non-academic people in the research process. Participatory action research (PAR) facilitates such research co-design and activities through scientist-farmer alliances (Armitage et al., 2009; Bohensky and Maru, 2011; Huntington, 2011; Mauser et al., 2013) and has been discussed among the agroecological community (Fernández, 2006; Altieri and Toledo, 2011; Duru et al., 2015; Pimbert, 2017). It proposes mixed and pluralistic methods to improve understanding of the complexities associated with the transformation of agri-food systems (Chambers, 2015) and includes participatory methods in research cycles, which enable the assimilation of research design and outcomes by non-academics.

The rationales of PAR and transformative agroecology are closely related. The primary idea is to avoid the linear research typical in many research and development (R&D) projects in agriculture, in which the end process is knowledge/technology transfer (Levidow et al., 2014). Instead, PAR proposes a framework based on research cycles, in which communities are no longer a research object but become a research actor (Kindon et al., 2007a). Their participation in research aims at enhancing their self-determination and autonomy over the process (Kindon et al., 2007b; Fals Borda, 2013) by defining, in collaboration with the researchers, the research problem and the research design, and evaluating the outcomes expected. Framing research in such a way requires a highly sensitive and adaptive methodology and a philosophical/epistemological position that goes beyond classical agricultural science (Kesby et al., 2007; Kindon et al., 2007a; Fals Borda, 2013; Chambers, 2015). As Levidow et al. (2014) argue, democratizing research and increasing funds for PAR and agroecological research are needed, along with research design for autonomous learning and action.

PAR has been applied for agroecological implementation. For instance, Guzmán et al. (2012) demonstrated the rationale and the *praxis* of using a PAR framework to build local food webs in Spain. The experience exemplifies how to conduct

TABLE 1 | The dichotomy of agroecology worldviews (based on and adapted from Levidow et al., 2014; Giraldo and Rosset, 2018).

	Transformative agroecology	**Conformist agroecology**
Vision	Agroecology is the alternative to industrial agriculture and is part of the struggle to challenge and transform monoculture, input dependency, and existing power structures. Facing the problem and vulnerability of conventional agriculture, it looks to transform the food system.	Agroecology offers tools to fine-tune industrial agriculture and conform to monoculture, input dependency, and power structures. It looks for adaptation to the problem created by conventional agriculture.
Approach to food	Food sovereignty and security	Food security
Agroecology as...	An interconnection of science, a set of practices, and social movements	A portfolio of sustainable practices
Disciplinary	Interdisciplinary/transdisciplinary of social, anthropological, and natural sciences	Multidisciplinary of natural sciences (based on agronomic sciences)
Social sciences scope	Promotes the use of critical and interdisciplinary methodologies and participatory action research (PAR)	Promotes the use of a rapid rural appraisal (RRA) and participatory rural appraisal (PRA) for contextualization
Main actors	Social movements, civil society organizations, and scientific councils such as *via* Campesina, SOCLA, and Landless Workers' Movement (MST)	Institutions such as the FAO, World Bank, CGIAR, and government bodies

PAR for agroecology with smallholders and presents a complete design of research phases with appropriate methods and participation levels. In a comparative study, Méndez et al. (2017) analyzed the lessons learned from two case studies integrating PAR and agroecology principles. They concluded that this methodological approach was essential for building long-term benefits of implementation *via* organized, constant, and trustworthy relations between researchers and the community.

Recent studies show the variety of PAR methods and instruments used for agroecological implementation. For instance, PAR opens space for role-playing games in multi-stakeholder arrangements to develop agroforestry landscapes supporting a collective plan for sustainable landscapes (Andreotti et al., 2020). Another example shows that a participatory guarantee system can support the agroecological transition in a local market network *via* PAR methods and principles (Chaparro-Africano and Naranjo, 2020). Thus, transformative methodologies, such as PAR, seem to be key to accomplishing the agroecological transition, particularly if it is to be upscaled. However, despite various case studies, there is no overview of how PAR has been included in agroecological research and the role PAR plays for the agroecological transition

This article provides a systematic review to understand to what extent PAR is prevalent in transformative agroecology, and which of the different PAR epistemic approaches contribute to the agroecological transition.

METHODS

We searched two scientific abstract and citation databases to identify articles that describe agroecology case studies: Scopus® and Web of Science™. These databases were chosen as they include only peer-reviewed research and allow for systematic searches. We considered using other databases (CAIRN, Dialnet, DOAJ, HAL, Latindex, Redalyc, Scielo) to find more local case studies, but these were discarded as they included neither advanced research tool nor Boolean values (nor both) that allow systematic queries.

The query terms used were agroecolog* and case* stud*. The use of the wildcard "*" allowed including several wordings for each term. For the term agroecology, we employed three possible ways of writing it that may appear in the literature: agroecolog*, agro-ecolog*, and agro*ecolog*, separated by the Boolean operator "OR." As the research query with sole agroecology resulted in many records (8313 in Scopus® and 6441 in Web of Science™), the choice of adding "case study" as a keyword was justified considering a systematic review. As Yin (2009) underline, case studies are an inclusive research design and permit various (mixed-) research methods. As such, the choice of using "case study" as keywords allowed us to have a representative sample of agroecological implementation research and methods used. In Scopus®, we typed query terms in the *Title–Abstract–Keyword* search field. In Web of Science™, the terms were typed in the *Topic* search field, equivalent to the search field *Title-Abstract-Keyword* in Scopus®. We selected articles published until the 31st of December 2018. The queries in the two abstract and citation databases yielded 856 records.

We used the PRISMA statement to constitute the article database (Liberati et al., 2009; Moher et al., 2009). We conducted four filtering phases: identification, screening, eligibility, and inclusion (**Figure 1**). The screening consisted of an overview of the article's metadata, such as titles, type of documents, subject area, and authors. This phase helped us to ensure the first filtering of the database by removing duplicates ($n = 246$), records that did not meet peer-reviewed journal article standards (introduction, methods, results, discussion, conclusion; book chapters mainly, $n = 45$), records without any of the search terms in their title, abstract and keywords ($n = 32$) and records that were not in English, French, or Spanish ($n = 31$). As a result, we selected 502 records for the subsequent phases.

The eligibility phase consisted of scrutinizing various article features to include the most relevant articles for the in-depth analysis. We filtered records that were not case studies ($n = 40$), not about agroecology ($n = 62$), not accessible ($n = 6$), and ones that were secondary case studies (i.e., relying exclusively on secondary data or reviewing case studies, $n = 45$).

It resulted in 347 articles to analyze primarily through a screening (see **Table 2** and **Supplementary Table S1**). The articles referring to agroecology as agro-ecological zoning (AEZ) were included solely in the screening analysis (Database 1). AEZ

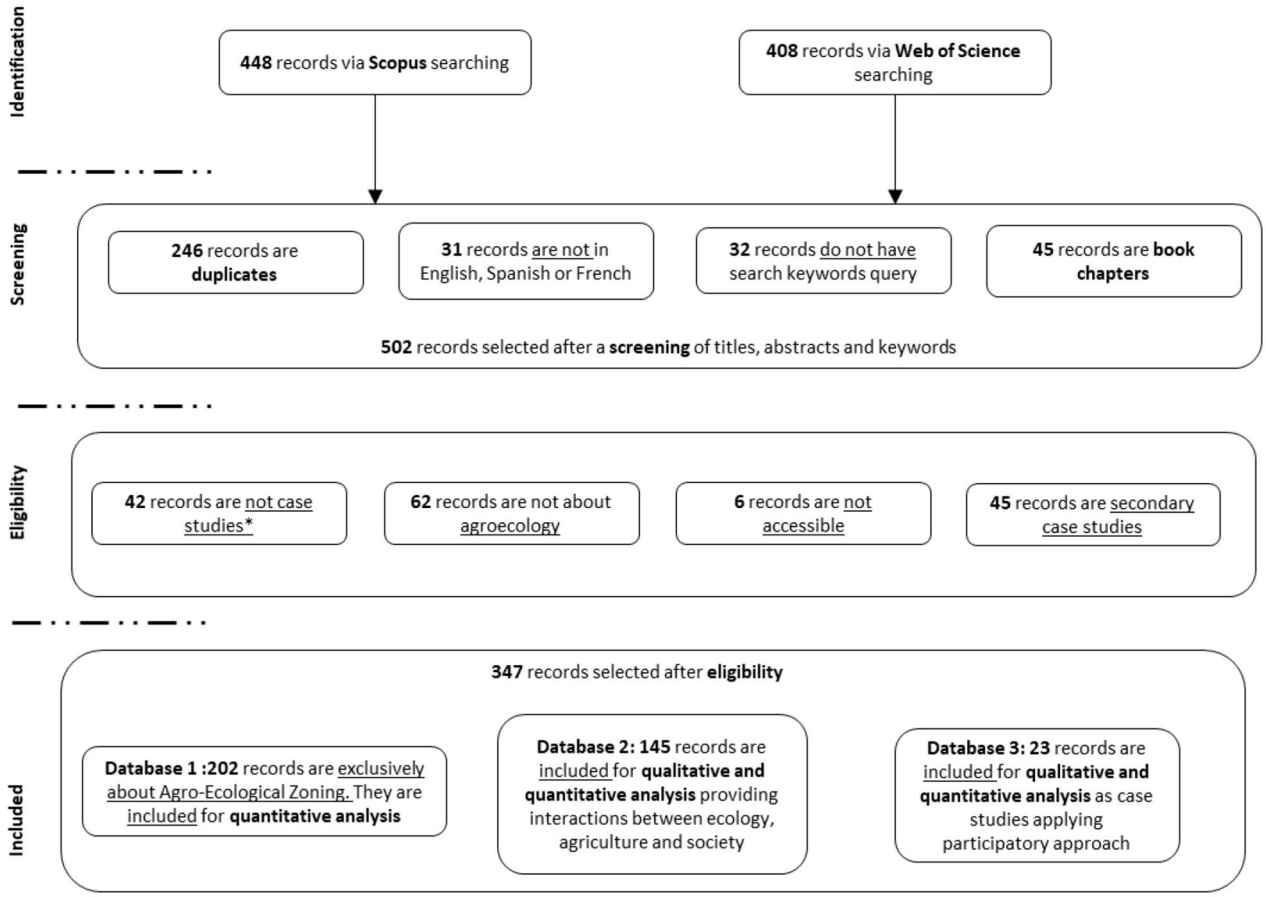


FIGURE 1 | PRISMA statement process undertaken for the selection of relevant articles. *22 records were annotated outlines; three records were literature reviews; two records were conceptual framework; two records were discussion paper; two records were editorial material; two records were about modeling without CS; one record was a forum paper; one record was a commentary; one record was a conference session summary; one record was a communication; one record was a dataset paper; one record was a Ph.D. thesis; one record was a review paper; one record was a synthesis; one record was a systematic review protocol.

defines an area's edaphic and climatic conditions for agricultural development purposes but does not provide any information about the interaction between agriculture and the broader socio-ecological food system. As such, most of the articles referring to AEZ do not use the meanings underlined by Wezel et al. (2009) but attribute the study area's characteristics through AEZ principles (see FAO., 1996).

The remaining articles were first analyzed by assessing the study area (continent, country, and region), the study's scale, and the academic disciplines involved. We mainly screened the titles, abstracts, and keywords to obtain information about these variables and coded articles in the database accordingly.

In a second step, we examined a set of articles ($n = 145$, Database 2) by screening the articles to highlight and code articles consistently with agroecological features, such as the type of agroecology (as a science, as a set of practices, as a movement) and the scale of agroecology (plot/field scale, agroecosystem, food system, food regime). Based on Giraldo and Rosset (2018), we also classified and coded the articles according to agroecological positioning, that is, their viewpoint on the agroecological transition (conformist or transformative).

The final step consisted of an in-depth analysis of case studies employing participatory methods ($n = 23$, Database 3, cells shaded in gray in **Supplementary Table S1**). By thoroughly reviewing the articles, we deepened the analysis on agroecological positioning and the participatory methods (i.e., inclusion of PAR or different methods), the rationale behind the method, and the epistemic perspective that the articles are engaging with. We mainly used Excel and R basic package for the descriptive analysis, chi-square analysis, and tables.

RESULTS AND ANALYSIS

Position on Agroecology in the Corpus

From all case studies selected ($n = 347$, see **Table 3**), 60% referred to agroecology as agro-ecological zoning, of which 202 articles were exclusively about AEZ (58%). A fair share of case studies focuses on agroecology as a set of practices (27% of overall; 64% of the articles without referring to AEZ). The proportion of

TABLE 2 | The analytical framework for analyzing extracted articles.

Analytical framework	Analysis based on abstract screening			Analysis based on article screening			In-depth analysis			
	Case study localization	*The scale of the study*	*The scientific disciplines called in*	*Type of agroecology*	*Scale of agroecology*	*Position on agroecology*	*Methods*	*Type of data collection*	*Methods*	*Epistemic perspective*
Database 1: Articles solely on AEZ ($n = 202$)	X	X	X							
Database 2: Articles providing interactions between agriculture, ecology, and society ($n = 145$)	X	X	X	X	X	X				
Database 3: Articles including case studies using a participatory approach ($n = 23$)	X	X	X	X	X	X	X	X	X	X

TABLE 3 | Type of agroecology referred to in the selected case studies.

Type of agroecology	Number of case studies ($n = 347$)
Agro-ecological zoning (AEZ)	209
As a science	46
As a set of practices	95
As a movement	44
Exclusive	
Exclusively AEZ	202
Exclusively as a science	25
Exclusively as a set of practices	50
Exclusively as a movement	24
Combined	
AEZ + As a science	1
AEZ + As a set of practices	6
As a science + As a set of practices	19
As a set of practices + As a movement	19
As a science + As a set of practices + As a movement	1

articles referring to agroecology as a science or as a movement was similar.

When crossing agroecological type and geographical location, case studies in Africa and Asia focus mainly on AEZ, that is, landscape zoning *via* agroclimatic conditions (**Figures 2**, **3** and **Supplementary Figure S1**). In comparison, case studies in the Americas and Europe, agroecology as a set of practices prevails. Hence, 22% of the articles ($n = 21/95$) conceptualize agroecology as a set of practices in South America and 13% in North America ($n = 12/95$). In South America, we found 45% of the articles addressing agroecology as a movement, with 60% of those in Brazil (**Supplementary Figure S2**).

In the corpus, the scale of the case study related significantly to the agroecological type (**Figure 4**). For example, most case studies referring to agroecology as a science focus on issues at the field/plot level (agronomic trials, biological surveys, and laboratory analyses). In contrast, case studies referring to agroecology as a movement focus on a larger scale, such as the food system (78%). Agroecology as a set of practices is studied at all scales; nevertheless, most of those case studies (70%) focus on either agroecosystem (33%) or the food system (37%).

The in-depth analysis shows more comprehensive positions that deepen agroecology's triptych as a science, a set of practices, or a movement. Above all, the primary justification for agroecology as a set of practices is that agroecology is a path for sustainable development (Holt-Giménez, 2002; Cools et al., 2003; Bergquist et al., 2012; Lanka et al., 2017; Ryschawy et al., 2017; Simon et al., 2017; van Niekerk and Wynberg, 2017; Stein et al., 2018; Bezerra et al., 2019). The rationale focuses on the diversification of techniques (praxis and technologies) that protect and respect local ecosystems, biodiversity, and ecologies (Holt-Giménez, 2002; Cools et al., 2003; Ryschawy et al., 2017; Simon et al., 2017; van Niekerk and Wynberg, 2017), but also the diversification of healthy food production (Bergquist et al., 2012; Stein et al., 2018). Furthermore, agroecological practices, *via* the ecological services generated, are shown to improve resilience to environmental degradation and climate change (Holt-Giménez, 2002; Rogé et al., 2014). Thus, agroecological practices are argued to improve sustainable livelihoods by restoring ecosystems and improving ecological services in agroecosystems (Lanka et al., 2017; Simon et al., 2017).

Besides studies demonstrating that agroecological practices improve sustainable livelihood *via* the preservation and use of ecological services and functions, other studies connect the different types of agroecology. Then, perspectives of agroecological praxis go beyond the portfolio of practices for sustainable agriculture. Practicing agroecology triggers new approaches to the food system *via* the design of the agroecosystem (Rogé et al., 2014; Ryschawy et al., 2017; Prost

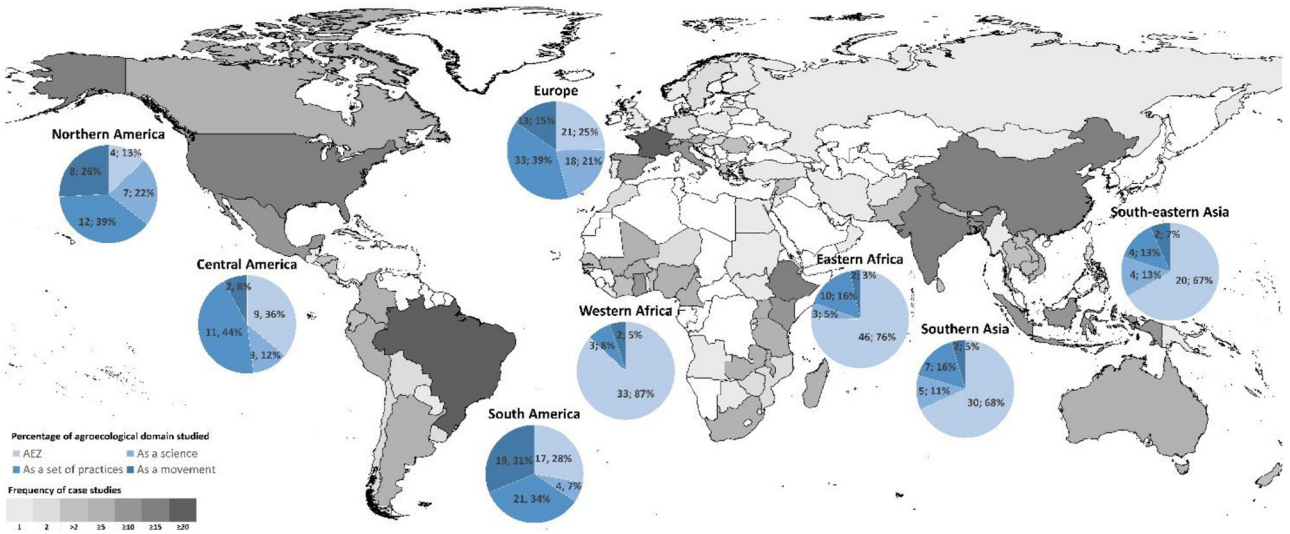


FIGURE 2 | Regional location of case studies and the percentage of the agroecological type studied in each region. Distribution: North America ($n = 23$); Central America ($n = 20$); South America ($n = 52$); Europe ($n = 68$); Western Africa ($n = 37$); Eastern Africa ($n = 54$); Southern Asia ($n = 42$); South-eastern Asia ($n = 27$).

	AEZ	As a science	As a set of practices	As a movement
Africa	89	4	12	3
Americas	31	14	44	27
Asia	66	12	15	4
Europe	21	18	33	13
Oceania	8		2	2

FIGURE 3 | Distribution of case studies according to the agroecological type and continental location. In the column heading, the gray bar represents the frequency of case studies on the continents. In the row label, the gray bar represents the frequency of case studies referring to agroecological type. Circles are proportional to the frequency of cases.

et al., 2018; Stein et al., 2018). This scope widens when practices reinforce cooperation between farmers, thus institutionalizing agroecological programs and strengthening community and family networks (Acevedo-Osorio et al., 2017; Lanka et al., 2017). Thus, agroecological practices become intertwined with social movements (or agroecology as a movement) through education and collective action (Guzmán et al., 2012; Rogé et al., 2014; Acevedo-Osorio et al., 2017; Bezerra et al., 2019).

Parallel to authors focusing on agroecological practices, the reviewed papers also indicated that agroecology as a movement supports sustainable agriculture (Holt-Giménez, 2002; Isgren and Ness, 2017; Stein et al., 2018). This line of thought considers that agroecology should empower farmers by realizing their influence in the food system (Tran, 2013; Rogé et al., 2014; Stein et al., 2018) and taking a significant part in food system decision making (Tran, 2013; Apgar et al., 2017; Misra, 2018). Agroecology is thus a movement that empowers small-scale farmers by increasing communitarian cooperation and subsequent autonomy (Holt-Giménez, 2002; Isgren and Ness, 2017; Lanka et al., 2017; van Niekerk and Wynberg, 2017). Thanks to such social empowerment, some authors suggest that agroecology diverges from conventional agriculture and "technocratic farming" (which focuses on food commoditization), and draws attention to structural problems in agriculture: input substitution, crop-livestock specialization, agrarian class conflicts, gender inequality, democratic processes (Isgren and Ness, 2017; Misra, 2018).

In turn, an agroecological transition is being proposed to restructure socioeconomic and political aspects in food systems

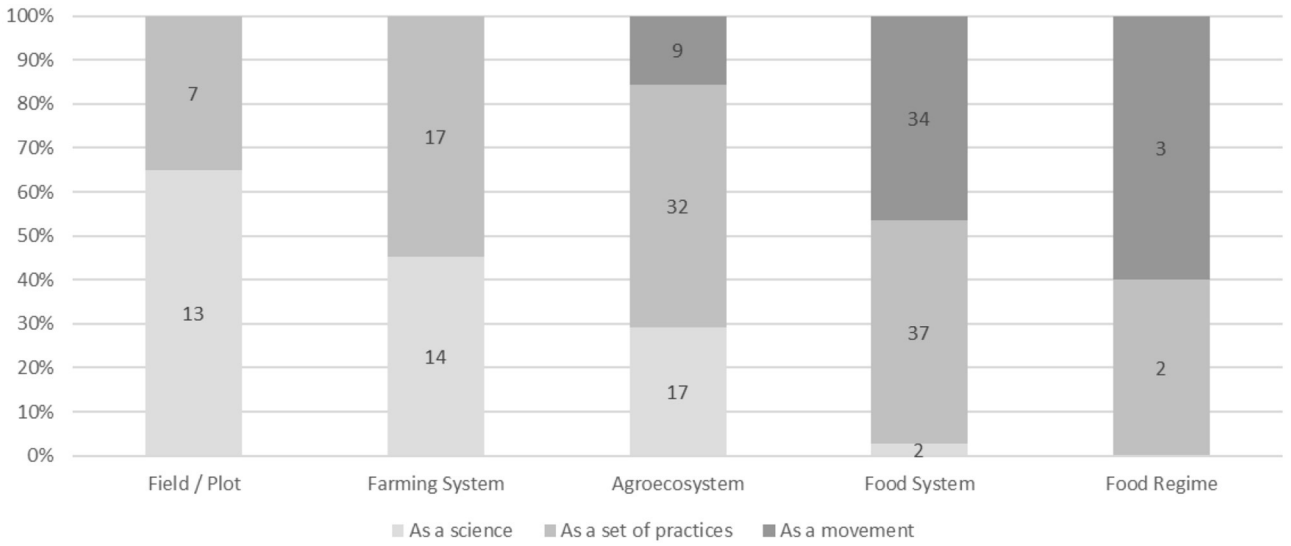


FIGURE 4 | Distribution of agroecological scale by the domain of agroecology considered in the articles.

to achieve a healthy, human-rights-based, and democratic decision-making process (Isgren and Ness, 2017; Misra, 2018). This relates closely to the food sovereignty movement that incorporates vital cultural significance into traditional knowledge and praxis (Wyckhuys and O'Neil, 2007; Acevedo-Osorio et al., 2017; Addinsall et al., 2017; Isgren and Ness, 2017; van Niekerk and Wynberg, 2017; Stein et al., 2018; Bezerra et al., 2019).

Use and Position of Participatory Methods

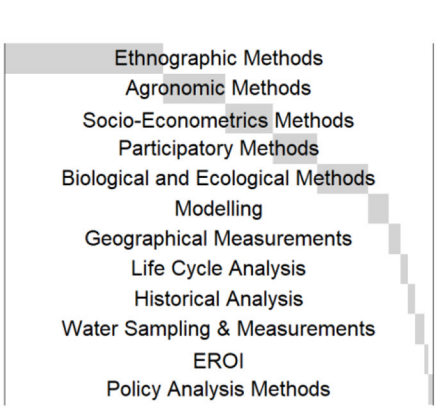
A balance of social science and life/natural science methods is applied among the case studies in our corpus. When comparing the agroecological types and methods (see **Figure 5** and **Supplementary Figure S3**), we observed that case studies conceptualize agroecology as a set of practices or as a movement when the research focus was within the social sciences. In comparison, life/natural science methods were used in case studies conceiving agroecology as a science or as a set of practices.

Ethnographic methods such as interviews (semi-structured and in-depth) and observations represent the majority (n = 84/145). Moreover, socio-econometric methods based on household surveys/questionnaires were well-represented, focusing mainly on the analysis of quantitative social phenomena.

One-sixth of the case studies (n = 23/145) employ participatory methods, including participatory rural appraisal (PRA), rapid rural appraisal (RRA), participatory learning, and PAR. As shown in **Figure 5**, participatory methods mainly focus on agroecology either as a set of practices or as a movement. All those case studies employ ethnographic methods (interviews and observation) and many use focus groups (n = 12/23), workshops (n = 6/23), and sociograms (n = 7/23). The scale of the studies focuses mainly on smallholder farming systems (Holt-Giménez, 2002; Guzmán et al., 2012; Hellin et al., 2013; Apgar et al., 2017), and in some cases specifically on autochthonous communities (Apgar et al., 2017; Lanka et al., 2017; Stein et al., 2018) or with a gendered focus (van Niekerk and Wynberg, 2017; Stein et al., 2018).

Farming communities are often engaged in research through cooperatives and formal associations (Holt-Giménez, 2002; Guzmán et al., 2012; Rogé et al., 2014; Acevedo-Osorio et al., 2017; Apgar et al., 2017; Isgren and Ness, 2017; Lanka et al., 2017) with a purposive selection of the population targeted by researchers (Holt-Giménez, 2002; Rogé et al., 2014; Ryschawy et al., 2017). In addition, some authors are looking to "confront" the knowledge between internal informants (mainly farmers) and external informants (mainly academics and experts) as a crucial part of the participatory approach (Cools et al., 2003; Hellin et al., 2013; Rogé et al., 2014; Addinsall et al., 2017; Ryschawy et al., 2017). Such studies aim to shed light on various perspectives on the agroecological transition, often pushed further *via* multi-stakeholder view analysis (Ryschawy et al., 2017; Simon et al., 2017, as in Borremans et al., 2018).

Above all, applications of participatory methods are diverse, reflecting various methodological approaches and agroecological positions. For example, several case studies applied focus groups with an extractive position, that is, as passive participation in which participants are consulted on a particular topic without opening space for co-learning, interaction, and potential self-mobilization (Hellin et al., 2013; Tran, 2013; Rogé et al., 2014; Addinsall et al., 2017; Lanka et al., 2017; van Niekerk and Wynberg, 2017; Borremans et al., 2018; Misra, 2018; Bezerra et al., 2019). In addition, PRA techniques in some studies consider a more reflexive approach. A popular one is participatory mapping, creating a space of discourse and visual support for knowledge sharing (Imbruce, 2007; van Niekerk and Wynberg, 2017). Other PRA exercises frequently employed are scoring techniques (Johansson et al., 2013) and sociograms (Bergquist et al., 2012; Guzmán et al., 2012). In the case of Bergquist et al. (2012), sociograms of energy flow systems



As a Science	As a set of practices	As a movement
8	61	38
20	21	1
5	20	7
3	19	8
17	16	1
7	7	
3	5	
2	3	
1	3	1
2	4	
2	1	
		3

FIGURE 5 | Distribution of case studies according to the type of methods applied and the field of agroecology conceptualized. The gray bar in column and row labels represents the frequency.

were designed to co-construct knowledge and compared expert knowledge with academic knowledge.

Some research underlines the importance of participatory methods as a set of tools to (co)-design a more sustainable agroecosystem and food system (Halbe et al., 2014; Ryschawy et al., 2017; Prost et al., 2018). The extensionist approach, whereby technicians and academics provide a step-by-step implementation of the new portfolio of practices, is substituted by an approach that allows farmers to design their action plan and strategies (Ryschawy et al., 2017; Prost et al., 2018). Thus, farmers become participants in the research for agroecosystem design, providing their knowledge and expertise throughout the process (Ryschawy et al., 2017; Simon et al., 2017). Participatory methods then become tools to merge autochthonous/local/traditional and academic knowledge for the co-construction of alternative land uses and shared governability of resources (Bergquist et al., 2012; Apgar et al., 2017; Stein et al., 2018), thus embedding the agroecological transition within the participatory methods (Bezerra et al., 2019). Furthermore, as Hellin et al. (2013) stated, participatory action research offers more tools to elaborate concrete *praxis* of the agroecological transition adapted to the communities' livelihood and priorities.

Only six articles reported the application of participatory action research. For example, Holt-Giménez (2002) demonstrated the link between PAR and the agroecological movement based on the farmer-to-farmer methodology (campesino-a-campesino) that has surged in Nicaragua. Here, participatory methods co-construct an assessment of impact of natural hazards on conventional agricultural plots and agroecological plots. Farmers' associations and research teams collaborate to create such assessments and the study renders well the habit (the praxis) of researching by the campesino-a-campesino movement.

As Apgar et al. (2017) mention, the framework of PAR aims to empower the communities (as an internal informant) for the research object/subject to say: "… the community in question decides, steers, and guides the research…" (p. 60). As such, the research team (as an external actor) is not the leading designer of the research but provides only guidelines and facilitates the research process. Isgren and Ness (2017) demonstrated that PAR could trigger this institutionalization (or associativity) and provide more farmer-to-farmer strategic planning and autonomy. As Bezerra et al. (2019) emphasized, agroforestry, and agroecological transition depend on applying those methods to encourage participatory learning, collective action, empowerment, and autonomy.

Guzmán et al. (2012) stated that the agroecological transition moves forward by applying PAR techniques to induce direct implementation. The study provides a straightforward methodology and techniques of PAR for designing and implementing agroecological practices, and, in parallel, encourages an agroecological movement in the study areas. The assessment of agroecological practices led to the development of local sustainable food networks with the communities' active participation.

Agroecology, Participatory Methods, and Epistemic Perspective

As shown previously, agroecological positioning intertwines with the methodological objective: how the researcher's position on agroecology connects with the methodological position, and subsequent participatory methods employed. We call this the epistemic perspective.

Most of the articles have a perspective on knowledge production as an in-depth analysis of a specific context, such as exploring the impacts of agroecological practices on smallholder livelihoods (Cools et al., 2003; Imbruce, 2007; Addinsall et al., 2017). These articles explore the synergies between the design of agroecological agroecosystems and livelihoods, conservation, ecosystem services, home gardening, food security, and sovereignty (Cools et al., 2003; Imbruce, 2007; Tran, 2013; Halbe et al., 2014; Addinsall et al., 2017; Lanka et al., 2017; van Niekerk and Wynberg, 2017; Stein et al., 2018). This analytical position often calls for repeating the study in another context to provide more evidence of the potential of agroecology (principle

of replicability) and deepening research questions (Hellin et al., 2013). Furthermore, various case studies call for deepening their studies on the grounds of a new conceptual framework applied to agroecological studies filling (new) research gaps (Imbruce, 2007; Wyckhuys and O'Neil, 2007; Bergquist et al., 2012; Halbe et al., 2014; Rogé et al., 2014; Addinsall et al., 2017; Lanka et al., 2017; van Niekerk and Wynberg, 2017; Prost et al., 2018).

Even when staying with the analytical process, this epistemic position is not purely monolithic: the researcher as an observer of reality and the "researched" as observation subjects. As we saw in the previous section, participatory methods extend the interaction with farmers and communities. An analytical position can be enriched by the participation of the research communities, even in a consultative position, to better understand their perceptions, priorities, and knowledge (Wyckhuys and O'Neil, 2007; Bergquist et al., 2012; Rogé et al., 2014; Stein et al., 2018).

Developing knowledge for formulating recommendations is a step further than keeping to a strict analytical position. Some authors mentioned a lack of employing autochthonous knowledge and local indicators to adjust recommendations to the context of the study area (Cools et al., 2003; Acevedo-Osorio et al., 2017). This allows constructing and co-designing better agroecosystem alternatives based on agroecological principles (Acevedo-Osorio et al., 2017; Isgren and Ness, 2017; Simon et al., 2017; Prost et al., 2018; Stein et al., 2018). Some authors emphasize the imperative for further research to highlight the perspectives of multi-actors in developing research incentives and development programs (Hellin et al., 2013; Borremans et al., 2018). As such, other authors recommend including smallholders and autochthonous viewpoints on the design of sustainable agroecosystems in public policies (Rogé et al., 2014; Ryschawy et al., 2017; Simon et al., 2017). Going further, Misra (2018, 485) suggests the necessity to democratize and reform the agricultural sector by empowering smallholders in decision-making over the food system that include agroecological and food sovereignty principles and subsequently improve their livelihoods. Isgren and Ness (2017) analyze agroecological transition potential and recommend in addition better transformative frameworks to foster agroecological implementation and movements.

The rationale of transformative knowledge production (a transformative epistemic perspective) occurred in our corpus. Thus, some case studies use research capacities to foster agroecological transition, notably *via* participatory (action) research methods. A transformative epistemic perspective employs participatory methods to identify local indicators and implement alternative practices, leading to farmers' design and direct application of sustainable agriculture (Holt-Giménez, 2002; Acevedo-Osorio et al., 2017; Bezerra et al., 2019). For example, in Holt-Giménez (2002), knowledge production is generated in collaboration with researchers and farmers, resulting from a long history of peasant-to-peasant movements aiming to emancipate rural communities.

The co-construction of knowledge with farmers is critical for agroecological transition as it explores communities' self-determination in the design of their sustainability (Apgar et al., 2017; Stein et al., 2018; Bezerra et al., 2019). It thus engages the researcher to work with established farming communities such as cooperatives and farmer associations (Holt-Giménez, 2002; Guzmán et al., 2012; Acevedo-Osorio et al., 2017; Apgar et al., 2017; Bezerra et al., 2019). Furthermore, as shown in Rogé et al. (2014, 807), participatory methods stimulate the communities to undertake self-determination by thinking about community-driven education and organizing collective action.

Finally, knowledge production with a transformative objective is a continuous process linked to collective action and decision-making in ecosystem management by and for the communities (Holt-Giménez, 2002; Rogé et al., 2014; Apgar et al., 2017). For example, the case of Guzmán et al. (2012) shows an iterative process based on a long-term vision to build and expand an agroecological food system. Furthermore, transformative science means that researchers are no longer external academic observers but part of a specific socio-historical context; consequently, the research design must include non-academics (Guzmán et al., 2012; Apgar et al., 2017).

DISCUSSION

Our systematic review shows that the broad agroecological research scope encompasses the three types of agroecology indicated by Wezel et al. (2009)—as science, as a set of practices, and social movement. We can see a majority of publications focusing on agroecology as a set of practices. This is not surprising, as most case studies focus on agronomic research, comparing practices and their effects on agroecosystems. However, our study shows that an in-depth analysis blurs the frontier between agroecology as science, a set of practices, and a movement. It supports the point made by Wezel et al. (2009) that the categorizing of agroecology could be fuzzy as its meanings are linked to cultural and socio-historical aspects. Therefore, the categorization is functional but always should be managed with care and not hinder the richness of agroecological positions taken by various studies.

Most case studies examining agroecology as a movement were located in the Americas, particularly in South America, whereas agroecology as a set of practices mostly occurs in North America, Central America, and Europe. It shows that the trends observed by Wezel et al. (2009) continued after more than a decade of their study. However, very few studies in Africa and Asia were found to use the agroecological typology of Wezel et al. (2009), despite calls for a global agroecological transition (De Schutter, 2010; Duru et al., 2015; Wezel et al., 2020). This does not necessarily preclude an agroecological transition taking place in Africa and Asia, but if that is the case, the science about it uses different terminology. Besides, our corpus shows a preponderant use of the AEZ type of agroecology in these regions. The meaning and application of AEZ might be out of the scope of agroecology as science, practices, and movement as it describes land use planning of a specific area for agriculture according to ecological and environmental conditions. Such polysemy of agroecology might lead to confusion of agroecology but reflect the "dispute" existing in the use of the concept: agroecology that connects science, *praxis*, and social movement against agroecology as a

technical option for agricultural commodification (Giraldo and Rosset, 2018).

Our results align with Wezel et al. (2009), indicating that the broader the research scope (from agroecosystem to food system to food regime), the more likely the agroecology studied relates to practices and/or a movement. Such studies included interdisciplinary research using social and anthropological methods encouraging a more complex view of agroecology, notably by opening farmers' perspectives instead of solely focusing on a conformist view of agroecology. However, most authors in our corpus conceive agroecology as a path to sustainable practices and do not explicitly position their discourse through the lens of transformative or conformist agroecology (Levidow et al., 2014; Giraldo and Rosset, 2018).

Few studies in the literature reflected the use of participatory methods in the agroecological field ($n = 23/145$, 16%). The in-depth analysis of these articles highlights that agroecology is not solely a portfolio of practices but a necessary adaptation that farmers employ to secure their food system while preserving the environment (Acevedo-Osorio et al., 2017; Lanka et al., 2017; Ryschawy et al., 2017). This confirms the vital link between agroecology and food sovereignty as suggested in the literature (McMichael, 2014; La Vía Campesina., 2018). Above all, our corpus shows that the agroecological transition requires farmers to have an active role in research. Consequently, a shift of the researcher's positionality must occur in terms of understanding the *praxis* of agroecology and the *praxis* of conducting research.

Most case studies did not include communities in the research design process. While community participation in research is an attempt to shift the scientific role and position, there are different levels of participation. For example, several case studies employed focus groups as a participatory method, with which researchers can consult the participants' perceptions of the study subject instead of looking for active participation over the study object/subject. In other words, a focus group can be employed as an extractive method, in which farmers and communities are external informants and nothing else. This is very different from research where the communities appropriate the research object, including reflecting on objectives and expected outcomes, and farmers become researchers themselves. However, if such techniques support the exchange of knowledge and blur the barrier of the unilateral relation between researcher and "researched," the use of these participatory methods shows different epistemic objectives. Accordingly, conducting PRAs can trigger a sense of mobilization. For instance, Rogé et al. (2014) showed that farmers, thanks to workshops and participatory assessments, called for deepening these participatory assessments by organizing themselves to engage in better agroecosystem management together, that is, by organizing collective action. Nevertheless, the full scope of what such participatory methodology offers is often not undertaken. It is barely a tool for co-constructing analysis on a specific topic, and not to open space for planning actions consequent to the knowledge construction (as in Bergquist et al., 2012).

Participatory methods can explore other directions, notably more emancipatory ones (Holt-Giménez, 2002; Bergquist et al., 2012; Guzmán et al., 2012; Apgar et al., 2017; Stein et al., 2018). Agroecological implementation must be preceded by the inclusion of smallholders in action research design and thus be steered by them (Méndez et al., 2017; Pimbert, 2017). Co-constructing knowledge then becomes evidence for fostering the transition when end-users of this knowledge are communities and academics, testifying to the place of PAR between empowerment and emancipatory epistemologies. Empowering communities in the research process is strongly intertwined with those communities' institutionalization as producer cooperatives or community associations (as in Apgar et al., 2017; Isgren and Ness, 2017). Many authors of our corpus mentioned and demonstrated that such a research process needs to be iterative and inherently based on various long-term research cycles (Holt-Giménez, 2002; Guzmán et al., 2012; Apgar et al., 2017).

As mentioned in the Methods section, we based our systematic review on case studies reported in scientific articles, thus limiting our scope to peer-reviewed research with scientific standards that may not fully represent the breadth of PAR in agroecology. For instance, extensive experience in transforming the food system in various countries has been published in book sections not indexed in scientific databases (Pimbert et al., 2017). In addition, experiences of civil society organizations with transformative agroecology illustrating the importance of empowerment and PAR have often been published in the gray literature. Likewise, other emancipatory and participatory approaches contributing to the agroecological transition that have been hardly documented in the scientific literature may also be found in the gray literature. For instance, the Farmer Field School (FFS) approach—in which farmers identify their problems, set their research objectives, and conduct research themselves—has been documented to be both empowering and helping farmers to build human, social, and natural capital (van den Berg et al., 2020). FFS borrowed methodological aspects from the experiential learning cycle, the learner-centered approach in adult education, and the framework for the technical, practical, and emancipatory learning, which are common methodological approaches in PAR. FFSs have been implemented within the field of agroecology, for instance, within integrated pest management in Africa (FAO., 2018b), on participatory plant breeding or on local food plants for nutrition (Visser et al., 2018; Cruz-Garcia et al., 2020). In these examples, farmers integrate local and scientific/technical knowledge while exploring their own solutions.

Additionally, we are conscious that the use of Scopus and Web of Science does not represent the full scope of scientific literature in this field and adding more contextualized abstract citation databases could potentially have enriched our study (such as Latindex, Scielo, Redalyc, Dialnet, DOAJ, HAL, and CAIRN). We chose Scopus and Web of Science to ensure that we only included papers that are in peer-reviewed journals that undergo scrutiny before being indexed as is the case in many similar synthesis studies (Magliocca et al., 2015), but we acknowledge that it renders a somewhat narrower scope. Future studies on the importance of participatory and empowerment approaches for agroecological transformation focused on reviewing gray literature and other abstract and citation databases are recommended. It has significant

implications for the inclusion of agroecological transition in policies on integrating such transition to empower smallholders in the choice of their food system.

CONCLUSIONS

Our study shows that, despite a need for transformative methods, such as participatory action research, to support the scale-up to an agroecological transition, these methods are not often used in case studies published in peer-reviewed articles. To further scale up the agroecological transition and achieve a global transition, one option can be broadening the scope of agroecological research in Africa and Asia, that is, focusing not solely on agroecology as science but addressing processes of the agroecological transition in these regions, using PAR and other participatory and empowering approaches. Additionally, understanding specific contexts and perspectives that bring agroecology to *praxis* in these regions should fill research gaps just as much for agroecological research as for PAR. Furthermore, with an environment that foster more democratic decision-making (*à la* Pimbert, 2017), PAR can offer farmers a space to trigger agroecological research, which is an essential component for a long-term vision and collective action.

However, this shift in epistemic perspective is a difficult task. Most of the experiences reflect a long-term relationship between farmers and researcher-activists (Holt-Giménez, 2002; Castellanet and Jordan, 2014; Méndez et al., 2017). Short-term project-based science, which is typically the way science is organized and conducted, hampers generating the long-term relationships necessary for successful PAR and the agroecological transition. To respond to such hindrance, Méndez et al. (2017) mentioned some experiences where projects are written within active consultation with smallholders, notably by sharing grant proposal documents and moving forward only when feedback is received. Therefore, changing the way science on agroecology is organized is necessary to provide researchers engaged in PAR with the time and resources needed to conduct studies that will advance more transformative agendas and achieve an agroecological transition (see for instance Pimbert, 2017; Pimbert et al., 2017). This opens the door to new questions on designing long-term PAR in agroecology when confronted with short-term project-based society.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

ES, OM, J-FL, GC-G, and MB contributed to conception and design of the study. ES organized the database and performed the statistical analysis and in-depth analysis of articles. ES and OM wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2021.709401/full#supplementary-material

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