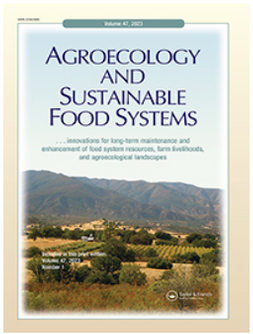

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A scoping review of participatory research methods in agroecology studies conducted in South Asia

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ABSTRACT

Agroecology is widely regarded and advocated as a participatory approach. This scoping review assessed the extent, range, and nature of available evidence on participatory research methods in agroecology studies conducted in South Asia. From 2069 records identified in two databases, we included a total of 27 studies, of which 20 were conducted in India. We found that a diverse range of participatory research methods have been used in agroecology studies. However, farmers are rarely engaged as study collaborators, co-researchers and decision-makers. We recommend that more researchers consider the full potential of participatory methods to develop relevant and effective agroecological solutions.

KEYWORDS

Agroecology; participatory; scoping review; South Asia

Introduction

Agroecology has been described as a transdisciplinary, participatory and action-oriented approach (Méndez, Bacon, and Cohen 2013) and experts have advocated for agroecology projects to "focus on solving real-world problems in close collaboration with the individuals and communities affected by those problems" (Mason et al. 2021). As an approach to agroecology research, local experiential and indigenous knowledge must be integrated with scientific knowledge through a collaborative, iterative and equitable research process.

Participatory research emphasizes direct engagement of local priorities and perspectives. It encompasses "research designs, methods, and frameworks that use systematic inquiry in direct collaboration with those affected by an issue being studied for the purpose of action or change" (Vaughn and Jacquez 2020). What these approaches all have in common is the value of doing research *with people*, rather than *on subjects*.

The distinguishing feature of participatory research is, therefore, the power of non-academic stakeholders to contribute to decision-making about the design and implementation of the research. In agroecology research, non-academic stakeholders include smallholder farmers, community members,

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civil society organizations, farmer associations, non-government organizations, local governments, and private sector organizations.

The degree of engagement and participation in the research process varies between and within studies, and the design of participatory research is likely to influence the impact it will have in the real world. Ideally, academic and non-academic partners will work together to co-design research that meets each other's needs.

Decisions about the degree of participation may happen at different steps or 'choice points' in the research process (Vaughn and Jacquez 2020). Figure 1 presents a framework to help research teams to co-design genuine and meaningful participatory research by considering whether to inform, consult, involve, collaborate and empower stakeholders.

Mason et al. (2021) used bibliometric and network analysis techniques to map the evolving landscape of agroecological research, showing how the field has transformed and diversified beyond the application of ecological principles to agricultural systems. This demonstrated that agroecology has become increasingly

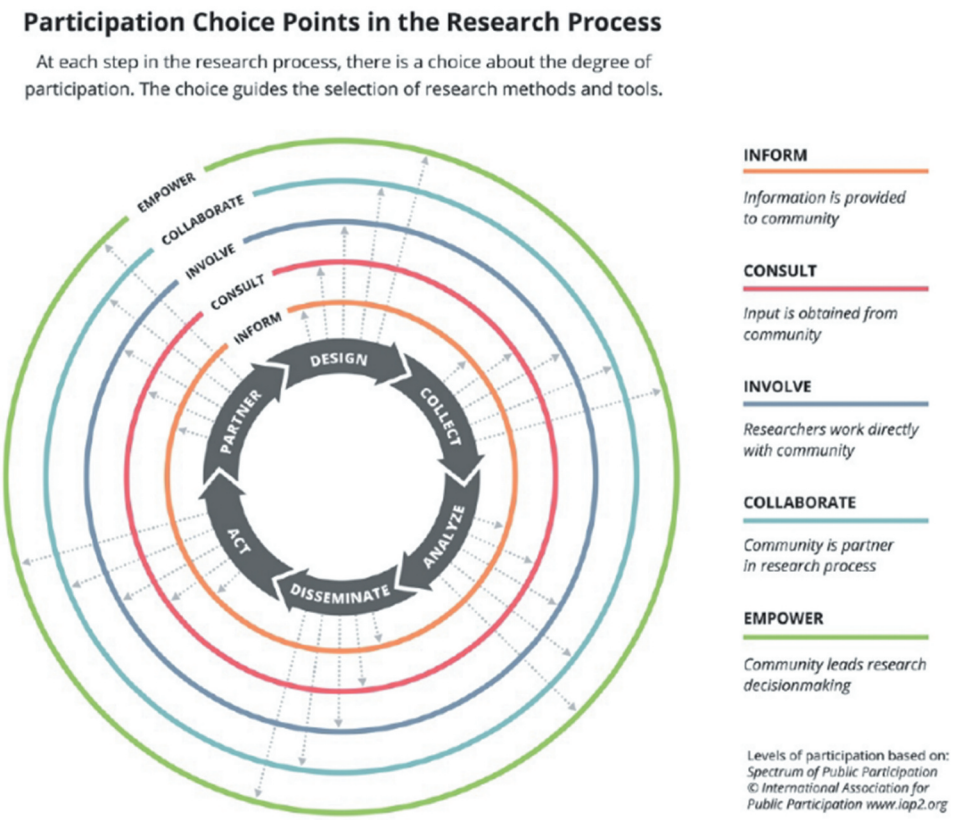

Figure 1. Participation choice points in the research process (source: Vaughn and Jacquez 2020).

concerned with social and political aspects of food production and the interests of different actors/stakeholders in food systems. Hence, the term 'participatory' has slowly become more commonplace in agroecology research papers since the 1980s (Mason et al. 2021). Mason et al.'s review focused on identifying 'research fronts' or sub-fields of agroecology at global level. It did not disaggregate studies by region or explore the details of methods used.

Our review seeks to expand the growing body of work examining participatory activity in agroecological settings and give impetus to studies that empower local populations. We are interested in participatory and community-led approaches, and developing innovative methods and tools, to engage farmers and rural communities in transitions to agroecology. When we explored the literature in 2020, we found no comprehensive or systematic reviews of participatory research methods in agroecology. Furthermore, the IMMANA (Innovative Methods and Metrics for Agriculture and Nutrition Actions) Evidence and Gap Map launched in 2019 highlighted a paucity of studies using community-led or participatory approaches in the interdisciplinary field of agriculture-nutrition research.

The field of agriculture is, however, vast and it is necessary to set parameters in any study to make the process manageable and the results focused. Considering agroecology on a regional basis is a sensible first step at bridging the gap in the literature and offers a potential template to other work in different geographical areas as well as a platform on which to build work in our chosen location. We have an existing research interest in South Asia (specifically the nations of Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka and the Maldives) and this fits with a particular need for work on participatory approaches in agroecology in this region (Food and Agriculture Organization of the United Nations 2015; Rahmanian et al. 2016). As Rahmanian et al. (2016, 198) note in their reflections on the FAO symposia on agroecology of 2014 and 2015, participants in Asia "stressed the need to move to a holistic and inclusive approach for the development of agroecology, enhancing connections and partnerships between producers' organizations and other public and private actors." The FAO report for Asia and the Pacific (Food and Agriculture Organization of the United Nations 2015, 4) is explicit; "As a marriage of knowledges of farmers' traditional knowledge and other sciences, agroecology calls for participatory research." Consequently, the purpose of our review was to inform the co-development of research proposals with academic and non-academic partners in South Asia.

This scoping review specifically addresses the following research question: ***What is extent, range, and nature of available evidence on participatory research methods in agroecology studies conducted in South Asia?*** Furthermore, it aims to explore the types of agroecology research in which participatory research methods have been used, and the ways in which participatory research methods have been used across the field of agroecology. It

will identify approaches where evidence exists, and highlight gaps and opportunities to engage individuals, communities and other non-academic stakeholders in the research process.

Methods

Review frameworks

We used two existing frameworks to ensure that our scoping review would provide a clear and comprehensive overview of available evidence on participatory research methods in agroecology studies conducted in South Asia.

First, we used the methodological framework for scoping reviews by Arksey and O'Malley (2005). This framework was developed based on the authors' experiences of conducting scoping studies and was chosen as one of our approaches as it provides a practical and logical approach to conducting scoping studies and has been extensively cited since its publication. The framework outlines five stages for conducting a scoping study or review (Arksey and O'Malley 2005):

(1) Identifying the research question
(2) Identifying relevant studies
(3) Study selection
(4) Charting the data
(5) Collating, summarizing and reporting the results

Second, we used the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) extension for scoping reviews, which provides reporting guidelines for this specific type of evidence synthesis and a checklist of 22 items to include when reporting a scoping review (Tricco et al. 2018).

We followed the PRISMA checklist except for three items. We did not register the review protocol (item 5), undertake critical appraisal of sources of evidence (item 12) or include studies (item 16). These are considered as optional items in the checklist and scoping reviews do not require formal appraisal of the quality of evidence, which is a key difference from systematic reviews (Sucharew and Macaluso 2019).

Search strategy

We developed a broad search strategy to identify articles relating to agroecology. We used similar search terms to Mason et al. (2021) including hyphenated and non-hyphenated spellings of agroecology (Tables 1 and 2) and included studies conducted in South Asia (the countries of which are similarly noted in Tables 1 and 2). Our linguistic capability meant limiting the scope of

Table 1. Search terms used in Web of Science (search conducted on 4th March 2021).

#	Search terms	
1	TS = (agroecolog*) OR TS = (agro-ecolog*)	8,328
2	TS = (agroecolog*) OR TS = (agro-ecolog*) **Refined by: COUNTRIES/REGIONS**: (INDIA OR PAKISTAN OR BANGLADESH OR NEPAL OR SRI LANKA OR BHUTAN OR AFGHANISTAN)	869
3	TS = (agroecolog*) OR TS = (agro-ecolog*) **Refined by: COUNTRIES/REGIONS**: (INDIA OR PAKISTAN OR BANGLADESH OR NEPAL OR SRI LANKA OR BHUTAN OR AFGHANISTAN) AND **LANGUAGES**: (ENGLISH)	869

Table 2. Search terms used in Scopus (search conducted on 4th March 2021).

#	Search terms	
1	(TITLE-ABS-KEY(agroecolog*)) OR (TITLE-ABS-KEY(agro-ecolog*))	10,861
2	(TITLE-ABS-KEY (*agroecolog**)) OR (TITLE-ABS-KEY (*agro-ecolog**)) AND (LIMIT-TO (AFFILCOUNTRY, *"India"*) OR LIMIT-TO (AFFILCOUNTRY, *"Pakistan"*) OR LIMIT-TO (AFFILCOUNTRY, *"Bangladesh"*) OR LIMIT-TO (AFFILCOUNTRY, *"Nepal"*) OR LIMIT-TO (AFFILCOUNTRY, *"Sri Lanka"*) OR LIMIT-TO (AFFILCOUNTRY, *"Bhutan"*) OR LIMIT-TO (AFFILCOUNTRY, *"Afghanistan"*))	1,201
3	(TITLE-ABS-KEY (*agroecolog**)) OR (TITLE-ABS-KEY (*agro-ecolog**)) AND (LIMIT-TO (AFFILCOUNTRY, *"India"*) OR LIMIT-TO (AFFILCOUNTRY, *"Pakistan"*) OR LIMIT-TO (AFFILCOUNTRY, *"Bangladesh"*) OR LIMIT-TO (AFFILCOUNTRY, *"Nepal"*) OR LIMIT-TO (AFFILCOUNTRY, *"Sri Lanka"*) OR LIMIT-TO (AFFILCOUNTRY, *"Bhutan"*) OR LIMIT-TO (AFFILCOUNTRY, *"Afghanistan"*)) AND (LIMIT-TO (LANGUAGE, *"English"*))	1,200

publication to studies published in the English language. We searched two multidisciplinary academic research databases: Scopus and Web of Science (both 1970 to present) in March 2021. The searches were applied to titles, abstracts and keywords.

While it might have been of interest to include variations on the term 'agroecology' (or 'agro-ecology') in our keyword searches this is a commonly used term, that we define below. Consequently, it would be expected to be included in any work within our search parameters. If the term was not included in search results, we would question whether these results were aiming to cover agroecology to the degree we identified (again defined below). Moreover, the volume of results that were initially returned from our searches was significant and to have included variations on either word, that could also have prompted a debate on accuracy, would have potentially increased the data to unmanageable proportions. However, this may be something that future studies consider as the literature is developed.

Study selection

Records identified during the search process were exported into Microsoft Excel (Version 2008) for de-duplication and screening. One reviewer (HO) removed the duplicates using the built-in function in Excel. Any other duplicates identified during the screening process were removed manually.

To be included in this review, studies were assessed against the following criteria:

- Primary research of any design
- Research conducted in one of more countries in South Asia (Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka and the Maldives)
- Relevance to agroecology
- Participatory research methods

Agroecology and participatory research methods are both deliberately broad concepts, and we have also adopted a broad and inclusive approach in this scoping review. The following definitions were used during the screening process:

Agroecology was defined as "the application of ecological concepts and principles to the design and management of sustainable agroecosystems" (Gliessman 2000). Studies were not included if they only referred to 'agroecological zones' or other geographical/physical indicators (regions, areas, locations, sites, conditions etc.) without also referring to agroecology as a practice or way of farming. This approach was consistent with the recent global review by Mason et al. (2021).

Participatory research methods were defined as any methods (qualitative or quantitative) that were designed or implemented in direct collaboration with farmers, communities, or any other stakeholders involved with or end-users of the research. The research team agreed a list of terms that were used to identify potentially relevant studies: participatory, participative, cooperative, community-led, collaboration, collaborative, co-design, co-production, co-research, engagement, bottom-up, grassroots, etc.

The study selection process was completed in two stages. Titles and abstracts were independently screened against the inclusion criteria by two reviewers (HO and ZI). Studies appearing to meet the criteria were obtained as full text articles, which were independently screened using the same criteria (HO, ZI and CL). Any differences or disagreements were resolved through discussion with the whole team.

Mapping process

Data were extracted as needed to describe the key characteristics of each included study: authors, year of publication, title, study location, study design, study participants (number and stakeholder group) and types of participatory methods used. To explore the extent, range and nature of the evidence in more depth, we used the United Nations Food and Agriculture Organization (FAO) 10 elements of agroecology as a framework to examine which aspects of agroecology were considered in each study (Food and Agriculture

Organization of the United Nations 2018). We also mapped included studies against the five levels of participation depicted in Figure 1; to show which studies used participatory research methods to inform, consult, involve, collaborate and empower stakeholders (Vaughn and Jacquez 2020).

Results

Search results

The PRISMA flow diagram shows how studies were identified and selected (Figure 2). A total of 2069 records were identified in the electronic database searches, of which 97 appeared to be potentially relevant. In the full text assessment, 27 articles met the inclusion criteria for this review (reasons for exclusion of 70 articles shown in Figure 2).

General characteristics

Table 3 presents key characteristics of the 27 studies included in this scoping review. The studies were conducted in four South Asian countries: India (n = 20) (Banerjee et al. 2014; Banik et al. 2006; Bhatta et al. 2017; Bijarniya, Parihar, and Jat et al. 2020; Bisht, Rana, and Pal Ahlawat 2020; Bonny et al. 2005; Borah et al. 2018; Chakraborty and Chaudhuri 2018; Friedrichsen et al. 2021; Gangwar, Tyagi, and Soni 2020; Kumar et al. 2019; Maikhuri, Rao, and Semwal 2001; Meinke et al. 2006; Rafiq, Najeeb, and Sheikh et al. 2016; Ramdas, Deepika, and Deepika 2001; Rawat et al. 2010; Reddy et al. 2016; Singh, Gohain, and Datta 2016; Singh, Singh, and Pandey 2014; Singh and Sureja 2008), Nepal (n = 5) (Bhatta et al. 2017; Gartaula et al. 2020; Pant et al. 2014; Yadav et al. 2018-1, 2018-2), Bangladesh (n = 3) (Bhatta et al. 2017; Ferdous et al. 2016; Kashem and Islam 1999) and Sri Lanka (n = 1) (Williams et al. 2018). We were unable to identify any relevant studies conducted in Afghanistan, Bhutan, Pakistan or the Maldives. The 27 included studies were published between 1999 and 2021, with more than half (n = 16) published since 2015.

Types of agroecology research

The included studies varied in terms of relevance to agroecology and specifically the 10 elements of agroecology (Table 4). All 27 studies were aligned with co-creation and sharing of knowledge since this element refers to participatory processes (and therefore integral to our inclusion criteria). Across the other nine elements, the most frequently represented in our included studies were human and social values (22/27 studies), culture and food traditions (22/27 studies) and resilience (20/27 studies). These elements are perhaps more

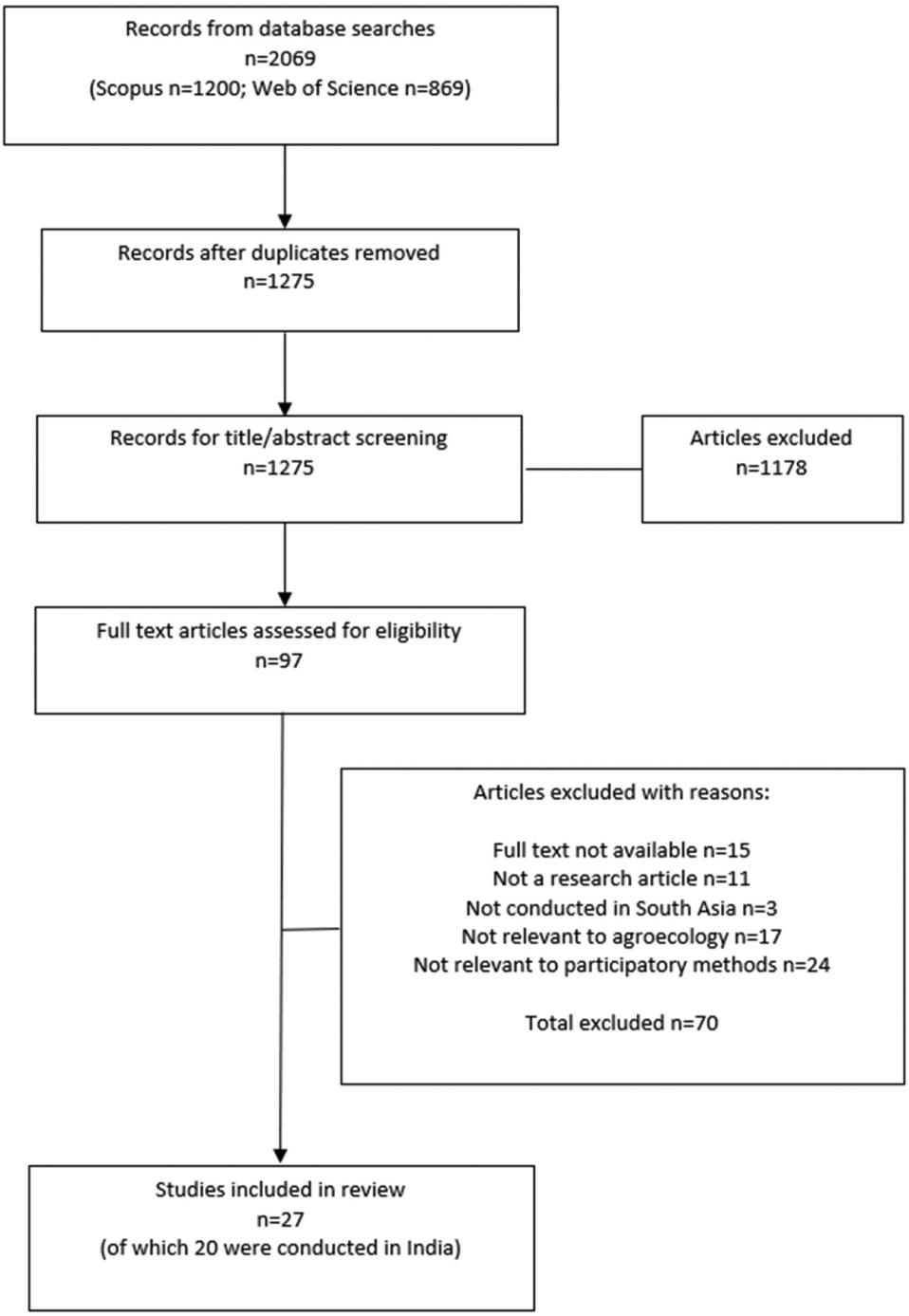

Figure 2. PRISMA flow chart for scoping review.

closely aligned to participatory research methods than others, such as synergies (11/27 studies), responsible governance (8/27 studies) and circular and solidarity economy (6/27 studies). However, the 10 elements of agroecology are quite broadly defined, interrelated and overlapping (Food and Agriculture

Organization of the United Nations 2018) and some studies referred to them less explicitly than others. With that in mind, Table 4 illustrates the diversity and range of agroecological studies that have used participatory research methods in South Asia.

Types of participatory research methods

Table 3 includes a summary of the participatory research methods used in each study. The most reported method was Participatory Rural Appraisal (7/27 studies) (Banik et al. 2006; Kashem and Islam 1999; Rafiq, Najeeb, and Sheikh et al. 2016; Ramdas, Deepika, and Deepika 2001; Reddy et al. 2016; Singh, Singh, and Pandey 2014; Singh and Sureja 2008). Participatory Rural Appraisal (PRA) is an approach that enables farmers (and rural communities) to assess their own situation and contribute knowledge and opinions into the planning and management of natural resource management and agriculture (Better Evaluation. Participatory Rural Appraisal 2021). Other participatory research methods that were specifically named in the study methods include community-level participatory exercises (Bhatta et al. 2017), participatory strategic research trials (Bijarniya, Parihar, and Jat et al. 2020), participatory interaction meetings (Bisht, Rana, and Pal Ahlawat 2020), Participatory Learning, Experimentation, Action and Dissemination (PLEAD) (Bonny et al. 2005), Integrated Farmer Participatory Watershed Management (IFPWM) Model (Friedrichsen et al. 2021), participatory village appraisal (Kumar et al. 2019), participatory climate risk-management workshops (Meinke et al. 2006) and participatory action research (Rawat et al. 2010). We also included eight studies that used methods or approaches that we judged to be participatory but were not explicitly described using that terminology in the study methods (Banerjee et al. 2014; Borah et al. 2018; Ferdous et al. 2016; Gartaula et al. 2020; Maikhuri, Rao, and Semwal 2001; Pant et al. 2014; Singh, Gohain, and Datta 2016; Williams et al. 2018). The 27 included studies varied in terms of the degree or level of participation reported (Table 5). A greater proportion of used participatory approaches to inform (13/27 studies), consult (all 27 studies) and involve (18/27 studies) stakeholders; compared to higher levels of participation such as shared decision-making, co-design and co-leadership of research, whereby participatory research methods were used to collaborate (9/27 studies) and empower (2/27 studies) stakeholders. We did not assess the degree of participation at each stage of the research process (as depicted in Figure 1) because in many cases the study methods were not reported in sufficient detail to enable us to do this equitably across all 27 included studies.

Table 3. Key characteristics of 27 included studies and participatory research methods used.

ID	Authors (year)	Title	Study location	Study design	Study participants	Participatory research methods
1	Banerjee et al. (2014)	Understanding biophysical and socio-economic determinants of maize (Zea mays L.) yield variability in eastern India	India	Farm surveys and pre-survey focus group discussions	180 farmers	The information gathered in the focus group discussions and farm visits was incorporated in a structured interview schedule constructed during a day-long stakeholder consultation.
2	Banik et al. (2006)	Natural Resource Inventory of Luppi Village, Eastern Plateau of India: Implications for Sustainable Agricultural Development	India	Natural resource inventory	14 farmers	Participatory Rural Appraisal (PRA)
3	Bhatta et al. (2017)	Agricultural innovation and adaptation to climate change: empirical evidence from diverse agro-ecologies in South Asia	Bangladesh India Nepal	Case studies	300 HH	Community-level participatory exercises in each site were used to find the community-level actions in the context of climatic and non-climatic drivers; participatory action research on climate-smart agricultural interventions
4	Bijarniya, Parihar, and Jat et al. (2020)	Portfolios of Climate Smart Agriculture Practices in Smallholder Rice-Wheat System of Eastern Indo-Gangetic Plains – Crop Productivity, Resource Use Efficiency and Environmental Foot Prints	India	Field experiments: randomized complete block design	Farmers in 3 climate smart villages	Participatory strategic research trials with different portfolios of climate smart agricultural practices under six scenarios.
5	Bisht, Rana, and Pal Ahlawat (2020)	The Future of Smallholder Farming in India: Some Sustainability Considerations	India	Exploratory survey	500 farmer HH	Participatory interaction meetings (focus group discussions)
6	Bonny et al. (2005)	Participatory Learning, Experimentation, Action and Dissemination (PLEAD): A Model for Farmer-Participatory Technology Evolution in Agriculture	India	Agro-ecosystem scanning and farmer-led experimentation	18 local farmer research groups	Participatory Learning, Experimentation, Action and Dissemination (PLEAD) model, which allows interactive participation of farmers, enabling them to be effective decision makers through the process of action–reflection–action (PRAXIS).

(*Continued*)

Table 3. (Continued).

ID	Authors (year)	Title	Study location	Study design	Study participants	Participatory research methods
7	Borah et al. (2018)	Chakhao (Black Rice; Oryza sativa L.): A culturally important and stress tolerant traditional rice variety of Manipur	India	Field survey and semi-directive interviews and focus group discussions	72 knowledge holders (farmers)	This study aims to document and describe the traditional knowledge and cultural practices of *Meitei* community associated with black rice cultivation; semi-directive interviews and focused group discussions were held with the identified knowledge holders.
8	Chakraborty and Chaudhuri (2018)	Integrating diverse knowledge bases for empowering local farmers in India	India	Semi-structured interviews	129 farmers	To construct a practical-based approach for knowledge integration from the ground level investigation as a pathway for farmer empowerment; to develop a participatory approach based informal communication model for disseminating the generated knowledge.
9	Ferdous et al. (2016)	Development of home garden model for year round production and consumption for improving resource-poor household food security in Bangladesh	Bangladesh	Dispersed experiments	12 HH including 5 landless, 4 marginal and 3 small farmers	Homestead resources, needs and choice assessments were performed with the active participation of the family members of the selected households.
10	Friedrichsen et al. (2021)	Yuck! Plural Valuation of Constructed Wetland Maintenance for Decentralized Wastewater Treatment in Rural India	India	Case studies; cross-sectional design	39 interview participants including scientists, farmers, privileged and socially disadvantaged community members	Integrated Farmer Participatory Watershed Management Model (IFPWM) is based on a participatory development model where a watershed committee is formed that consists of various stakeholders who represent a wide range of religions, gender, and castes. This study was designed to facilitate communication and knowledge exchange between researchers and participants using semi-structured interviews, observations, and tours of the constructed wetlands and surrounding communities.

(*Continued*)

Table 3. (Continued).

ID	Authors (year)	Title	Study location	Study design	Study participants	Participatory research methods
11	Gangwar, Tyagi, and Soni (2020)	Connecting Farmers to Knowledge, Networks and Institutions for Agroecological Sustainability	India	Case study	Technology developers, volunteers, community trainers, and participating farmers	Collaborative and participatory evaluation during two successive crop cycles of rice cultivation.
12	Gartaula et al. (2020)	Indigenous knowledge of traditional foods and food literacy among youth: Insights from rural Nepal	Nepal	Explanatory sequential mixed-methods research design	Farmers, local community researchers and 226 high school students	Conversations with farmers evolved into a systematic research inquiry on the knowledge and interests of youth with respect to food and agriculture; knowledge test questions were developed in consultation with local community researchers who had been working with the local farmers.
13	Kashem and Islam (1999)	Use of Indigenous Agricultural Technologies by the Rural Men and Women Farmers in Bangladesh	Bangladesh	Semi-structured interviews	159 farming HH	PRA
14	Kumar et al. (2019)	Farm typology analysis and technology assessment: An application in an arid region of South Asia	India	Farm household survey and typology analysis	256 farm HH	Participatory village appraisals and participatory prioritization of interventions; co-designed context-specific interventions through an iterative participatory process; ex-ante evaluated such interventions to inform multiple stakeholders.
15	Maikhuri, Rao, and Semwal (2001)	Changing scenario of Himalayan agroecosystems: loss of agrobiodiversity, an indicator of environmental change in Central Himalaya, India	India	Cross-sectional surveys	60% of HH in 30 villages and 75 key informants	Village level monitoring of agroecosystem change; Rapid Rural Appraisal (RRA) methods and discussions with elders and knowledgeable people were used and verified through field observations.
16	Meinke et al. (2006)	Actionable climate knowledge: from analysis to synthesis	India	Case studies	91 small and medium farmers	Participatory climate risk-management workshops with the initial aim of simply providing a forum for peer-to-peer discussions.

(*Continued*)

Table 3. (Continued).

ID	Authors (year)	Title	Study location	Study design	Study participants	Participatory research methods
17	Pant et al. (2014)	Adaptive Transition Management for Transformations to Agricultural Sustainability in the Karnali Mountains of Nepal	Nepal	Case study	16 farming communities	Adaptive Transition Management approach for transformations to agricultural sustainability. An emergent mixed methods research process including direct observation through project interventions and focus group discussions with smallholder farmers.
18	Rafiq, Najeeb, and Sheikh et al. (2016)	Farmer's participatory varietal selection in Japonica rice (Oryza sativa L.) in Kashmir valley	India	Field trials: randomized block design	112 farmers in mother trials at five locations	PRA was conducted at 16 sites representing high altitude mountain agro ecologies of Kashmir valley and 50 farmers at each site were identified for such study.
19	Ramdas and Ramdas, Deepika, and Deepika (2001)	Changing Livelihoods, Livestock and Local Knowledge Systems: Women Stake their Claim in Andhra Pradesh and Maharashtra	India	Participatory research	Local people's organizations and NGOs	PRA, case studies, informal group meetings and focus group meetings; men and women from the community were trained as 'barefoot researchers' to document different aspects of their livelihood and knowledge systems.
20	Rawat et al. (2010)	Managing natural resources with eco-friendly technologies for sustainable rural development: a case of Garhwal Himalaya	India	Participatory action research	2329 participants in 35 on-site training courses	Participatory action research to train and build capacity of local farmers and other user groups and motivate them to adopt promising, low cost, hill-specific rural technologies in participatory mode.
21	Reddy et al. (2016)	Participatory Rural Appraisal in Drylands: A Holistic Approach for Getting Insight into an Agro-Ecosystem Analysis	India	PRA	1615 farm families	PRA using include transect walk, agro-ecological mapping, social mapping, time trend, seasonal calendar, gender analysis, timeline, livelihood analysis, technology mapping, consequence diagram, problem – solving tree, etc.
22	Singh, Gohain, and Datta (2016)	Upscaling of agroforestry homestead gardens for economic and livelihood security in mid–tropical plain zone of India	India	Exploratory survey	16 farmers' families	Participating homestead families were trained on agroforestry homestead gardening practices [i.e. the study was implemented in direct collaboration with farmers].

(*Continued*)

Table 3. (Continued).

ID	Authors (year)	Title	Study location	Study design	Study participants	Participatory research methods
23	Singh and Sureja (2008)	Indigenous knowledge and sustainable agricultural resources management under rainfed agro-ecosystem	India	PRA	20 farmers from each of 7 villages = 140 in total	PRA method for analyzing the present use of natural resources and its management practices in relation to agriculture at village level.
24	Singh, Singh, and Pandey (2014)	Agro-biodiversity in rice–wheat-based agroecosystems of eastern Uttar Pradesh, India: implications for conservation and sustainable management	India	PRA	180 farmers	Personal interviews and PRA
25	Williams et al. (2018)	Assessing the Impacts of Agrobiodiversity Maintenance on Food Security Among Farming Households in Sri Lanka's Dry Zone	Sri Lanka	Household and community surveys	1400 smallholder farming HH in 30 communities; follow-up survey with subsample of 50 HH	Survey was developed in collaboration with a group of Sri Lankan agricultural specialists; sampling frame was developed for each community based on registered voter lists vetted by local farmer organization leaders; survey instruments were developed in collaboration with two researchers from the local training institute; homegarden inventories were conducted by garden tenders and researchers.
26	Yadav et al. 22018-1	Agro-morphological diversity of Nepalese naked barley landraces	Nepal	Field experiments: on-farm diversity block trials	Farmers in four mountainous locations (n not stated)	**Participatory** plan breeding approach: all agronomic and management practices were followed as per the farmer's practice; farmers were invited to watch the diversity block in the field to determine whether farmers are consistent in naming and describing varieties.
27	Yadav et al. 22018-2)	Diversity sourcing of foxtail millet through diversity assessment and on-farm evaluation	Nepal	Field experiments: on-farm diversity block and yield trials	Farmers in two mountains districts (n not stated)	**Participatory** plan breeding approach: local farmer's practices were followed to raise the crop; farmers were invited to watch the diversity block in the field to determine whether farmers are consistent in naming and describing varieties.

PRA = Participatory Rural Appraisal

Table 4. Elements of agroecology that were considered in each included study.

Included studies		FAO 10 elements of agroecology									
ID	Authors (year)	Diversity	Co-creation and sharing of knowledge*	Synergies	Efficiency	Recycling	Resilience	Human and social values	Culture and food traditions	Responsible governance	Circular and solidarity economy
1	Banerjee et al. (2014)	●	●					●	●		
2	Banik et al. (2006)	●	●		●	●	●	●	●		●
3	Bhatta et al. (2017)	●	●	●	●		●	●	●	●	
4	Bijarniya et al. (2020)		●		●	●	●				
5	Bisht et al. (2020)	●	●	●	●		●	●	●	●	●
6	Bonny et al. (2005)		●		●			●	●		
7	Borah et al. (2018)	●	●		●		●	●	●		●
8	Chakraborty and Chaudhuri (2018)		●					●	●		
9	Ferdous et al. (2016)	●	●		●	●	●	●	●		
10	Friedrichsen et al. (2021)		●	●	●	●		●	●	●	
11	Gangwar et al. (2020)		●		●	●					
12	Gartaula et al. (2020)		●				●	●	●		
13	Kashem and Islam (1999)		●	●	●	●	●	●	●		
14	Kumar et al. (2019)	●	●	●	●	●	●	●	●		●
15	Maikhuri et al. (2001)	●	●	●		●	●	●	●		
16	Meinke et al. (2006)		●				●	●		●	
17	Pant et al. (2014)	●	●	●			●	●	●	●	●
18	Rafiq et al. (2016)		●		●						
19	Ramdas and Deepika (2001)	●	●		●			●	●		
20	Rawat et al. (2010)		●		●	●	●	●	●		
21	Reddy et al. (2016)	●	●	●	●	●	●	●			
22	Singh et al. (2016)	●	●	●	●	●	●	●	●		
23	Singh and Sureja (2008)	●	●	●	●	●	●	●	●	●	
24	Singh et al. (2014)	●	●	●	●	●	●	●	●	●	
25	Williams et al. (2018)	●	●				●	●	●	●	●
26	Yadav et al. (2018-1)	●	●				●		●		
27	Yadav et al. (2018-2)	●	●				●		●		
Total number of studies representing each of the 10 elements		**17**	**27**	**11**	**18**	**13**	**20**	**22**	**22**	**8**	**6**

*Co-creation and sharing of knowledge include participatory processes, therefore this element was integral to all studies included in this review.

Discussion

This scoping review provides an overview of the extent, range and nature of available evidence on participatory research methods in agroecology studies

conducted in South Asia. We included 27 relevant articles, of which 16 were published since 2015, suggesting that participatory approaches have become more commonly used in recent years. This finding is consistent with a recent study using bibliometric and content analysis techniques, which showed that use of the word 'participatory' in agroecology studies has gradually increased over time (Mason et al. 2021). Given that participatory and action-oriented approaches have been widely advocated by experts in agroecology (Méndez, Bacon, and Cohen 2013), the adoption and development of participatory research methods appears to have been slow – or perhaps they are not always clearly reported. Indeed, we identified some studies that we considered to be participatory in nature, which did not use the term 'participatory' at all.

As we approached the final stages of our review, a global systematic review was published that explored the use of participatory methods in agroecology, and the extent to which participatory approaches contribute to agroecology transitions (Sachet et al. 2021). The authors of this opted to limit the search results by including "case study" as a keyword. They identified 23 case studies using participatory methods, out of 145 case studies in total that were relevant to agroecology. Only three of the 23 case studies were also included in our scoping review (Bhatta et al. 2017; Meinke et al. 2006; Rawat et al. 2010). We included primary research of any design and, therefore, our review captured more relevant studies from South Asia than did the systematic review.

Despite these differences, the findings of this recent systematic review complement our findings and demonstrate the potential for developing this body of work through further investigations. Sachet et al. also identified a diverse range of participatory methods, including participatory rural appraisal (PRA), rapid rural appraisal (RRA), participatory learning, and participatory action research. They described some participatory methods as 'extractive' meaning that "participants are consulted on a particular topic without opening space for co-learning, interaction, and potential self-mobilization" (Sachet et al. 2021).

This reflects our findings on the degree or level of participation in agroecology studies not limited to case studies (Table 5). We found that many studies used participatory methods to obtain or exchange knowledge with farming communities, or to engage farmers in study implementation on their land, rather than empowering them as collaborators and co-researchers throughout the research process. However, we identified two studies conducted in India that exemplified a deeper level of participation and engagement with farmers and farming communities i.e. the end-users of the research.

Bonny et al. (2005) developed the PLEAD model (participatory learning, experimentation, action and dissemination) through consultation and collaboration with 18 farmer research groups in Kerala. This farmer-researcher partnership model promotes interactive co-learning and innovation, with farmers empowered as knowledge holders, decision-makers and problem

Table 5. Degree or level of participation reported in each included study.

Included studies		Degree of participation reported				
ID	Authors (year)	Inform	Consult	Involve	Collaborate	Empower
1	Banerjee et al. (2014)		✓			
2	Banik et al. (2006)		✓	✓		
3	Bhatta et al. (2017)		✓	✓	✓	
4	Bijarniya, Parihar, and Jat et al. (2020)		✓			
5	Bisht, Rana, and Pal Ahlawat (2020)		✓	✓		
6	Bonny et al. (2005)	✓	✓	✓	✓	✓
7	Borah et al. (2018)		✓			
8	Chakraborty and Chaudhuri (2018)	✓	✓	✓		
9	Ferdous et al. (2016)	✓	✓	✓		
10	Friedrichsen et al. (2021)	✓	✓	✓		
11	Gangwar, Tyagi, and Soni (2020)	✓	✓	✓	✓	
12	Gartaula et al. (2020)	✓	✓	✓	✓	
13	Kashem and Islam (1999)		✓			
14	Kumar et al. (2019)	✓	✓	✓	✓	✓
15	Maikhuri, Rao, and Semwal (2001)		✓			
16	Meinke et al. (2006)	✓	✓	✓		
17	Pant et al. (2014)		✓	✓	✓	
18	Rafiq, Najeeb, and Sheikh et al. (2016)		✓			
19	Ramdas and Ramdas, Deepika, and Deepika (2001)	✓	✓	✓	✓	
20	Rawat et al. (2010)	✓	✓	✓	✓	
21	Reddy et al. (2016)	✓	✓	✓	✓	
22	Singh, Gohain, and Datta (2016)	✓	✓			
23	Singh and Sureja (2008)		✓			
24	Singh, Singh, and Pandey (2014)		✓			
25	Williams et al. (2018)	✓	✓	✓		
26	Yadav et al. 22018-1		✓	✓		
27	Yadav et al. 22018-2)		✓	✓		
Total number of studies representing each level of participation		**13**	**27**	**18**	**9**	**2**

solvers. It resulted in the development of effective coping strategies and interventions to enhance the long-term sustainability of local agroecosystems.

Kumar et al. (2019) used participatory village appraisals to understand the priorities and constraints of smallholder farmers in three districts in Rajasthan. Study methods included transect walks, household surveys, focus group discussions, consultation meetings and a multi-stakeholder interactive platform. A participatory process was used to develop a farm household typology (reflecting biophysical, socio-economic and ecological characteristics) and subsequently co-design and pilot context specific interventions for each household type.

We acknowledge some limitations of this scoping review. We endeavored to be systematic, consistent, inclusive and transparent during the study selection process. However, this was challenging with criteria based on two broad concepts: agroecology and participatory research methods. As we identified,

additional key words that some authors may use synonymously for these concepts could have been included. We may also have included some studies that other reviewers would not have included. This challenge has been observed in the wider literature on participatory research methods:

"Although the results of participatory research are prolific in the literature, it can be difficult to isolate concrete descriptions of how the research was collaboratively conducted" (Vaughn and Jacquez 2020).

We focused on two academic research databases (due to resource limitations) and we may have missed additional relevant studies published in the gray literature. Scopus and Web of Science are two of the largest databases and they only include articles published in peer-reviewed journals, thus providing some level of assurance of coverage and study quality. Future reviewers could improve on our approach by consulting the gray literature and developing a more targeted search strategy. The FAO Agroecology Knowledge Hub is a valuable resource containing not just articles but video, learning and other materials outside of traditional academic search parameters that could be a useful starting point for this. Moreover, it may be of interest to compare agroecological projects with more 'conventional' agriculture work, identifying if there are more innovative participatory approaches in the former than the latter, or if conventional agriculture can be part of the increasing participation discussion.

In conclusion, this scoping review illustrates that a diverse range of participatory research methods have been used in agroecology studies in South Asia. However, farmers and other non-academic stakeholders largely remain in the position of participants and informants. They are rarely engaged as study collaborators, co-researchers and decision-makers. We recommend that more researchers consider the full potential of participatory methods to develop relevant and effective agroecological solutions.

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