Data Paper

The Use of Participatory Modelling Methods in Agri-Environmental Research – A Systematic Mapping Dataset

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Abstract

Participatory modelling (PM) is a transdisciplinary research approach that involves stakeholder in a modelling process to develop or improve qualitative or quantitative models. To better understand the potential uses of PM in the emerging field of agroecology living lab research, I conducted a systematic search of the peer-reviewed literature and describe 78 participatory agri-environmental case studies in this dataset. Bibliographic data are included and each case study is described in terms of main goal(s), PM method(s) used, involved stakeholders and their contributions and the level of stakeholder participation in the project. I also extracted key metadata (if available), such as publication type and year, study location (country), funding source, project duration and outcomes beyond publications. This dataset adds value by revealing clusters and associations of methods and goals, by showing the dominating role of researchers in this type of participatory research, by pointing out the absence of PM in certain areas of agricultural production, such as hydroponic farming or viticulture and by providing a comprehensive foundation for the related research article. It also contained data not used in the related research article that could provide a basis for future research, such as linking methods, goals and stakeholder involvement with other metadata or comparing this agri-environmental research and other areas.

Keywords

literature review, agriculture, environment, capacity building, evaluation, living lab

Related research article

Klemm T, Piorr A, Ewert F: Participatory modeling methods and their use in agri-environmental research – A review. Agronomy for Sustainable Development (under review)

Context

I systematically assessed and mapped the range of participatory modelling (PM) methods used in agri-environmental peer-reviewed research, to compare and contrast their capabilities and limitations, to understand which methods are used in tandem, and to catalogue use cases for each method. This can help:

1. PM researchers venture into new areas,
2. institutions aiming to expand their research portfolio, and
3. grant agencies to judge the rigidity of research proposals involving PM.

Value of the data

- The data provide insights into the use of 19 participatory modelling methods in peer-reviewed, participatory agri-environmental research;
- The dataset shows which methods are more dominant than others, shows dominant combinations of methods and use cases (project goals) for these modelling methods, shows the stakeholder participation levels of each study;
- The dataset aggregated metadata, such as funding organisations, study duration, country and outputs beyond peer-reviewed publications, to geolocate studies globally, assess prominent funding organisations and inform research timelines for similar proposals;
- Bibliographic information, such as author(s), year, and journal is provided for each publication;
- Researchers, funding organisations and research institutions may benefit from the linkages between methods and study goals, which may inform research proposals and help evaluate them and may help broaden research capabilities of scientists and institutions;
- The data can be analysed quantitatively and qualitatively.

Dataset description

The main data file is an Excel spreadsheet that contains 188 peer-reviewed papers, 78 case studies that were assessed and 110 papers that were filtered out during full-text analysis with reasons for their rejection. The spreadsheet contains 58 columns with numeric and text data that describe each study in qualitative and quantitative ways. Inclusion criteria regarding methods and context are listed in Table 1 and a description of each data column is provided in supplemental material file "1 – dataset column description.docx".

Table 1.

Inclusion criteria during the screening process for method and topical context.

Participatory modelling method	Agri-Environmental context
Used in primary research: field project, data analysis; no editorial, opinion or review papers; no conference poster/abstract	Covering the field of agricultural production, irrigation management, livestock production, crop production or water resource management
Application of one PM method or comparison of several methods through fieldwork	No conceptual or review papers, no horticulture, no aquaculture
English language	English language

Also included are text files in RIS format with bibliographic information about the 78 analysed case studies, the 110 papers filtered out during full-text analysis, and 857 papers filtered out based on title and abstract screening.

Table 2 lists the files of this dataset and their contents.

Table 2.

File names and descriptions of the accompanying data files. Files 1, 3, 4 and 5 can be found in the supplemental material of this paper. File 2 must be downloaded via the DOI link under "Repository location".

File name	Description
1 – dataset column description.docx (Suppl. material 1	Description of the data columns in file "2 – full-text analysis.xslx"
2 – full-text analysis.xslx	Analysis of 188 publications (78 case studies and 110 papers, which were filtered out during full-text analysis based on criteria listed in Table 3). This file can be downloaded via the DOI link under "Repository location".
3 - analysed case studies_RIS.txt (Suppl. material 2)	Bibliographic information of the 78 case studies that were analysed
4 - papers filtered out during full-text analysis_RIS.txt (Suppl. material 3)	Bibliographic information of the 110 publications that were filtered out during full-text screening
5 - papers filtered out based on title and abstract screening_RIS.txt (Suppl. material 4)	Bibliographic information of the 857 publications that were filtered out during title and abstract screening

Table 3.

Levels of stakeholder engagement and their description. Adapted from Meadow et al. (2015).

Level	Mode of stakeholder engagement	Motivation for research from …	Type of relationship, flow of information	Stakeholder involvement
1	Contractual	Researchers	Unidirectional information flow from researchers to stakeholders	No active involvement; receiver of information, knowledge or technology
2	Consultative	Researchers	Researchers consult with stakeholders, diagnose a problem, try to find solution	At specific stages, such as problem definition, research design, dissemination of findings
3	Collaborative	Researchers or Stakeholders	Stakeholders and researchers are equal partners, joint diagnosis of the problem	Continuous with emphasis on specific activities, depending on the problem
4	Collegial	Stakeholders	Equal partners; Researchers actively encourage capacity-building and/or local research beyond the project	Throughout

Creation dates

The dataset was created between April and September of 2023.

Language

English

Licence

CC BY

Repository name

BonaRes Repository

Repository location

https://doi.org/10.4228/zalf-7cf8-a030

Publication date

7 May 2024

Methods

The search strategy was adapted from the Guidelines and Standards for Evidence Synthesis in Environmental Management, Version 5.1 (Collaboration for Environmental Evidence 2022). I followed a transparent search and selection methodology as laid out by the ROSES flow diagram for systematic maps (Haddaway et al. 2018).

An online search for English language, peer-reviewed publications was conducted via the databases Web of Science, Scopus, Agricola, AGRIS, Dimensions, and Livivo, in the title, abstract, and author keywords fields using the following initial search string:

("Participatory Model*" OR "Collaborative Model*" **AND** (Agricultur* **OR** Farm* **OR** Cultivation **OR** Husbandry **OR** Viticultur* **OR** Horticultur* **OR** Hydroponic* **OR** "Food system*" **OR** Crop* **OR** Wheat **OR** Rye **OR** Oat* **OR** Rice **OR** Plant* **OR** Produce **OR** Cereal **OR** Animal* **OR** Livestock **OR** Cattle **OR** Sheep **OR** Goat)).

I adapted this string to fit the syntax requirements of each database, as stated in Table 4.

Table 4.

List of used databases, respective search strings, and number of results.

Database and URL	Search String	Results
Web of Science All Databases* (www.webofscience.com) *included Web of Science Core Collection, Biological Abstracts, BIOSIS Citation Index, BIOSIS Previews, CABI: CAB Abstracts, Current Contents Connect, Data Citation Index, Derwent Innovations Index, FSTA – the food science resource, KCI-Korean Journal Database, SciELO Citation Index, and Zoological Records	(TI=("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))) OR (AB=("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))) OR (AK=(("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))))	1015
Scopus (www.scopus.com)	TITLE-ABS-KEY (("Participatory Model*" OR "Collaborative Model*" AND (agricultur* OR farm* OR cultivation OR husbandry OR viticultur* OR horticultur* OR hydroponic* OR "Food system*" OR crop* OR wheat OR rye OR oat* OR rice OR plant* OR produce OR cereal OR animal* OR livestock OR cattle OR sheep OR goat)))	444

Database and URL	Search String	Results
Agricola (search.nal.usda.gov) (Search in "All Fields")	("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))	46
AGRIS (https://agris.fao.org/agris-search) (Search in "Publications and Datasets")	"Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat)	0
Dimensions (app.dimensions.ai) (Search in "Title and Abstract")	("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))	121
Livivo (www.livivo.de) (Search in "All Fields")	("Participatory Model*" OR "Collaborative Model*" AND (Agricultur* OR Farm* OR Cultivation OR Husbandry OR Viticultur* OR Horticultur* OR Hydroponic* OR "Food system*" OR Crop* OR Wheat OR Rye OR Oat* OR Rice OR Plant* OR Produce OR Cereal OR Animal* OR Livestock OR Cattle OR Sheep OR Goat))	54

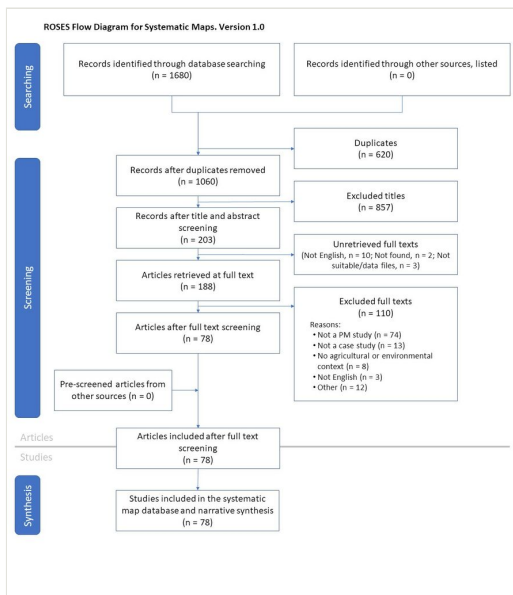The screening strategy followed these steps (see also Fig. 1):

Figure 1.

ROSES flow diagram of the screening process (adapted from Haddaway et al. (2018)).

1. Automatically remove duplicates in EndNote;

2. Screen titles and abstracts in Rayyan (manual removal of some undetected duplicates; not shown in Fig. 1);

3. Download full texts of remaining included publications;

4. Screen full texts.

Fig. 1 shows a ROSES flow diagram of the screen process with the number of publications eliminated in each screening step.

Inclusion criteria for publications are listed in Table 1.

The categories for case study goals were derived from Fig. 1 in Kelly et al. (2013) and in consultation with experts.

I determined stakeholder participation based on criteria by Meadow et al. (2015) which were adapted slightly (Table 3).

Data were extracted from 78 studies through careful examination of the entire full-text of each case study. Most PM methods (e.g., system dynamics, agent-based modelling, companion modelling, causal loop diagramming etc.) were always stated in the publication, while some methods, which were not named in the publication (e.g., informing/contributing to a numerical model or numerical model prototyping), were derived from their description in the publication. Descriptions of all methods is available as supplemental material in the related research publication to this data paper listed in the section Specifications Table. A list of ten methods that could not be associated with one commonly known and is also included in the supplemental material of the companion paper.

Study goals were determined from descriptions in the publications using the criteria in Table 5.

Table 5.

Study goals and their criteria. Note: Most analysed case studies had two or more goals, described in dataset file "2 - full-text analysis.xlsx," column AX ("Describe the study goal(s)") and column AZ ("Describe the stakeholder contribution"). However, in cases where goals played only a minor role, they may not be listed in these columns but only become apparent from reading the respective publications.

Goal	Criteria
Understanding Systems	Improve understanding of the social, ecological, or economic system surrounding the study
Social learning	Enable participants to learn by participating in the research, for example, by playing role-play games or engaging in group model building

Goal	Criteria
Improve Management	Contribute to developing or comparing management scenarios towards outcomes desired by stakeholders or based on various environmental conditions
Improve policies	Contribute to developing or improving policies or assessing the effectiveness of current policies based on scenarios, action plans, or desired outcomes that were co-developed by stakeholders
Understand values and decisions	Assess motivations of stakeholders towards or against certain decision options, or evaluate their priorities given various options
Improve empirical/mathematical/ numerical models	Use stakeholder expertise to include new components or modify existing ones in empirical/mathematical/numerical models
Understand and steer implementation/transformation process	Examining stakeholder's decision making and/or scrutinise their rationale to find alternative decision pathways and/or determine pathways for transformation
Understand social systems/ power relationships	Gain insights into social networks, hierarchies, and/or information flows between and among stakeholders
Improve predictions, projections, forecasting	(Similar to goal "Improve empirical/mathematical/numerical models"); show how PM can improve projections, predictions, and/or forecasts
Other	Chosen when goals were too different from the other categories, but relevant enough to be considered, for example, maintain natural habitat, reduce land-use conflicts, empower communities

Limitations

The dataset includes only peer-reviewed research, no grey literature. Due to the search methodology, in particular, not using names of specific participatory modelling methods, but instead searching for umbrella terms, such as "participatory model*", I likely missed publications that may have mentioned the method in title, abstract, or author keywords, but not that the study applied a PM approach. I did not evaluate the "success" of the case studies and did not question the authors' choice of their methods. As a result, the data do not allow judgement about whether a method or set of methods are suited to achieve the goals of the studies they were used with.

Acknowledgements

Conflicts of interest

The authors have declared that no competing interests exist.

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Supplementary materials

Suppl. material 1: Dataset column description doi

Authors: Klemm, Toni
Data type: Microsoft Word document
Brief description: Description of the data columns in file "2 – full-text analysis.xslx" (which can be downloaded via the DOI link under "Repository location").
Download file (15.31 kb)

Suppl. material 2: Analysed case studies RIS doi

Authors: Klemm, Toni
Data type: RIS file
Brief description: Bibliographic information of the 78 case studies that were analysed.
Download file (198.93 kb)

Suppl. material 3: Papers filtered out during full-text analysis RIS doi

Authors: Klemm, Toni
Data type: RIS file
Brief description: Bibliographic information of the 110 publications that were filtered out during full-text screening.
Download file (302.96 kb)

Suppl. material 4: Papers filtered out based on title and abstract screening RIS

doi

Authors: Klemm, Toni
Data type: RIS file
Brief description: Bibliographic information of the 857 publications that were filtered out during title and abstract screening.
Download file (2.50 MB)