

Public participation geographical information systems (PPGIS)

Participatory research methods for sustainability – toolkit #1

Participatory mapping is a useful approach to engage the general public and stakeholders to communicate place-based values, behaviour, preferences and observations. The approach informs social-ecological research and land-use planning. In land-use planning, PPGIS is applicable, for example, in initial phases or for assessing project outcomes. This toolkit gives guidance on participatory mapping surveys.

Nora Fagerholm , María García-Martín , Mario Torralba , Claudia Bieling , Tobias Plieninger 

Public participation geographical information systems (PPGIS). Participatory research methods for sustainability – toolkit #1
GAIA 31/1 (2022): 46–48 | **Keywords:** participatory mapping, research methods, sustainability, transdisciplinarity

Participatory mapping combines cartography with participatory approaches to put the knowledge, experiences, and aspirations of people on a map.¹ Under this umbrella term, public participation geographical information systems (PPGIS) refers to the use of GIS and modern communication technologies to engage the general public and stakeholders in participatory planning and decision-making. In practice, there is ambiguity in participatory mapping terminology and alongside PPGIS the term participatory GIS (PGIS) is also often used.

PPGIS approaches have recently found strong interest and are applied in a variety of fields, for instance in urban green space development, protected area planning, or coastal zone management.² PPGIS is often used to (Fagerholm et al. 2021):

1. identify place-based values, perceptions, or attitudes, such as landscape values, ecosystem services (box 1), environmental quality factors, perceived problems or unpleasant experiences;
2. analyse spatial behaviour of people, most notably everyday practices and activities, such as mobility patterns, routes travelled, or places visited;

3. communicate preferences or visions about future land use;
4. gather place-based observations through so-called geographic citizen science, such as trail networks or wildlife observations.

Procedure

The first step of a PPGIS study is to identify the purpose and intended outcomes of collecting spatially explicit data, ideally done in collaboration with stakeholders. Data collection is most commonly based on a web-based mapping survey. Respondents fill in a survey either individually or assisted by a facilitator. They are selected through different approaches: random sampling can promote better representativeness of population, although respondent rates have remained rather low (below 15%). In crowd-sourced or volunteer sampling it is typically challenging to reach a balanced respondent profile. Survey panels can also be applied or targeted sampling, for instance to reach pupils at schools.

In a PPGIS survey, the mapped spatial data can be points, lines, or polygons, with point features being most simple and most frequently mapped (Brown and Fagerholm 2015). Additional open or structured follow-up questions may facilitate understanding or contextualising the mapped attributes. Many PPGIS surveys additionally collect nonspatial data, such as respondents' socio-economic-demographic characteristics, worldviews, motivations, or well-being (Fagerholm et al. 2021).

Survey design critically affects PPGIS data quality. There is a need to balance the quantity of mapped data with related descrip-

Assoc. Prof. Nora Fagerholm, PhD | University of Turku | Department of Geography and Geology | Vesilinnantie 5 | 20500 Turku | Finland | ncfage@utu.fi

Dr. María García-Martín | Swiss Federal Research Institute WSL | Land Change Science | Birmensdorf | Switzerland | maria.garcia-martin@wsl.ch

Prof. Dr. Claudia Bieling | University of Hohenheim | Societal Transition and Agriculture | Stuttgart | Germany | claudia.bieling@uni-hohenheim.de

Dr. Mario Torralba | mario.torralba@uni-kassel.de

Prof. Dr. Tobias Plieninger | plieninger@uni-goettingen.de

both: University of Kassel and University of Göttingen | Social-Ecological Interactions in Agricultural Systems | Göttingen | Germany

© 2022 by the authors; licensee oekom. This Open Access article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).
<https://doi.org/10.14512/gaia.31.1.10>

Received November 30, 2021; revised version accepted January 14, 2022 (double-blind peer review).

1 On participatory mapping, definition and resources see also the platform of the International Society for Participatory Mapping (ISPM) at <https://pmappingsociety.mn.co>.

2 See Participatory Mapping Institute (PMAP) at <https://participatorymapping.org>.

tions of the data. The quality of PPGIS data depends also on additional factors such as accuracy, precision, type of spatial data collected, and data usability (Brown and Fagerholm 2015).

PPGIS analysis aggregates individual-level data to the scale of the survey population or subgroups of it. Spatial analysis can be grouped in three phases (Fagerholm et al. 2021):

1. the **Explore** phase, which involves analysis methods that are exploratory and descriptive in character. Assessment of spatial data quality (e.g., representativeness of the sample and validity of mapped data) is an important part of this phase.
2. the **Explain** phase, in which the aim is to understand the relationships between PPGIS data and multiple other geospatial data sources serving as potential explanatory variables (such as land cover, road network data, plant or animal population data, or spatial plans).
3. the **Predict/Model** phase, in which the aim is to generalise mapped attributes to other places and contexts and to understand future realities using the relationships found in the *Explain* phase.

PPGIS survey design has also potential for mixed-methods analysis. For example, collected data may include place descriptions that are analysed qualitatively. A PPGIS survey is similar to a traditional questionnaire approach, developed and implemented

often by researchers or planners to elicit information from respondents. However, building a PPGIS process based on knowledge co-creation and deliberative valuation (e.g., through workshops where research questions are defined and results discussed) is crucial to ensure that individual values articulated in PPGIS surveys become shared in collective environmental decision-making processes and to discuss issues of conflict, power, and equity (e.g., Kenter et al. 2019). Going towards a co-creation PPGIS approach also promotes capacity building and social learning among the participants.

Skills and resources needed

Successful PPGIS application requires basic skills in social sciences and geoinformatics. Completing a scientifically valid PPGIS study takes a minimum of one year. The most effective PPGIS platforms are license-based, for example, *Maptionnaire*, *Ushahidi*, *Mapping for change* and *Survey123*, but there are also open-source tools such as *OpenDataKit* and *KoBoToolbox*. Open-source GIS and statistics software can be used for data analysis. Codes of ethics for public participation and the treatment of geospatial data must be considered for responsible PPGIS practice and differ between countries. Making collected PPGIS data publicly avail-



BOX 1: Mapping local people’s ecosystem services perceptions around agroforestry systems

Many of Europe’s landscapes are shaped by agroforestry – a traditional land management practice appreciated for its rich ecosystem services. Ecosystem services, that is, the benefits people derive from nature, are typically assessed through biophysical or economic valuation models. In this study of a Spanish agroforestry landscape, a PPGIS approach was developed as a complement to such expert-based assessments (Fagerholm et al. 2016). The interest was in identifying the ecosystem services that matter to local people. Using an online survey, 219 residents were interviewed and asked to map those places in the landscape that they appreciate for different ecosystem services of local relevance. Outdoor

activities, harvesting of wild plant resources, and aesthetic values were the local ecosystem services of highest importance to the locals (figure 1). Ecosystem services showed also varying importance for respondents, for example, outdoor recreation was valued to a lower degree among people working in agriculture and forestry compared to other respondents. Lands in public (rather than private) ownership and easily accessible lands turned out as hotspots of these ecosystem services. The findings were discussed in a regional stakeholder workshop (figure 2), and later the PPGIS approach was transferred to 13 other areas in Europe.

FIGURE 1: Local residents identifying and mapping ecosystem services in a Spanish agroforestry landscape: screen capture from the online survey designed by the research team using the survey platform *Maptionnaire*.

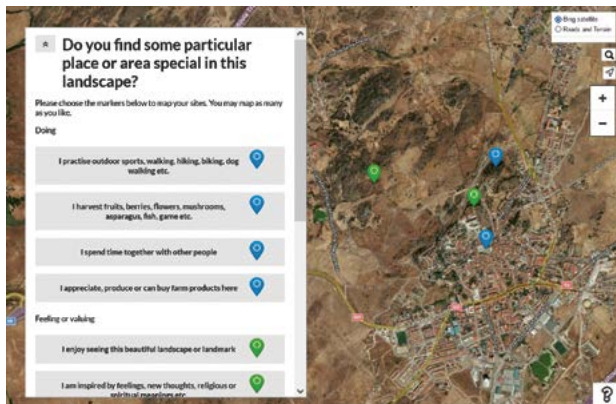


FIGURE 2: Regional workshop held in 2016 to discuss the findings of the PPGIS study. The workshop was facilitated with the help of a local facilitation company called Observatorio para una Cultura del Territorio: <https://observatorioculturayterritorio.org>.



© María García-Martín

able, following data protection regulations, allows analysis and review by a wider public.

Strengths and weaknesses

- In social-ecological research, the PPGIS approach promotes the assessment of perception-based and often also intangible, intrinsic, or symbolic values of nature, ecosystems, or landscapes.
- The PPGIS approach has high potential for multidisciplinary analysis by integration with biophysical spatial data or qualitative place descriptions.
- A web-based PPGIS approach can reach people widely and facilitates participation in land-use planning but some parts of the society can be excluded due to varying availability of technological skills and devices. Therefore, PPGIS works best in combination with other methods of participation.
- Self-administered online surveys are time-efficient and unrestricted by a specific time and place, but the survey response rate can remain low, which makes it difficult to control data quality.
- Facilitated surveys are time-consuming as each person needs to be met individually, but there is a possibility to control representativeness and data quality. Resources are needed for inviting respondents and training facilitators.

- For data collection the most sophisticated platforms are license-based. Different levels of ambitions are possible in the analysis of PPGIS data.

The authors sincerely thank the anonymous reviewer for the helpful comments.

References

- Brown, G. G., N. Fagerholm. 2015. Empirical PPGIS/PGIS mapping of ecosystem services: A review and evaluation. *Ecosystem Services* 13: 119–133. <https://doi.org/10.1016/j.ecoser.2014.10.007>.
- Fagerholm, N., E. Oteros Rozas, C. M. Raymond, M. Torralba Viorreta, G. Moreno, T. Plieninger. 2016. Assessing linkages between ecosystem services, land-use and well-being in an agroforestry landscape using public participation GIS. *Applied Geography* 74: 30–46. <https://doi.org/10.1016/j.apgeog.2016.06.007>.
- Fagerholm, N. et al. 2021. A methodological framework for analysis of participatory mapping data in research, planning, and management. *International Journal of Geographical Information Science* 35: 1848–1875. <https://doi.org/10.1080/13658816.2020.1869747>.
- Kenter, J. O. et al. 2019. Loving the mess: Navigating diversity and conflict in social values for sustainability. *Sustainability Science* 14: 1439–1461. <https://doi.org/10.1007/s11625-019-00726-4>.

In this series, we aim to alert GAIA readers to useful toolkits for participatory research methods for sustainability. If you would like to contribute a toolkit description, please contact gaia@oekom.de.

GAIA Masters Student Paper Award

The international journal GAIA – Ecological Perspectives for Science and Society invites Masters students to participate in the 2023 GAIA Masters Student Paper Award.

Masters students are encouraged to submit their results from research-based courses or from Masters theses in the field of transdisciplinary environmental and sustainability science.

Submission guidelines and more information:

www.oekom.de/zeitschriften/gaia/student-paper-award

Deadline for submission: November 28, 2022.

The winner will be selected by an international jury and will be granted a prize money of EUR 1,500 endowed by the Selbach Umwelt Stiftung and Dialogik gGmbH, as well as a free one-year subscription to GAIA, including free online access. The winner may also be encouraged to submit his or her paper for publication in GAIA.

DIALOGIK
gemeinnützige Gesellschaft für Kommunikations-
und Kooperationsforschung mbH

Selbach Umwelt Stiftung

GAIA