Geodesign as a boundary management process: Co-creating and negotiating sustainable landscape futures.

Participatory research methods for sustainability – toolkit #11

Geodesign is a participatory research and planning process that manages diverse boundaries and combines place-based local knowledge and values, design and planning expertise, and geographic information science for the purpose of collaborative and well-informed spatial planning. It is particularly effective in managing boundaries between stakeholders, knowledge frameworks, and technology. Geodesign is valuable in the early stages of planning, facilitating problem characterization and citizen involvement, as well as impact assessment.

Sarah Gottwald, Christian Albert, Gustavo Arciniegas, Marta Ducci, Sana Jajeh, Ron Janssen, Rory Taylor

Geodesign as a boundary management process: Co-creating and negotiating sustainable landscape futures.
Participatory research methods for sustainability – toolkit #11 | *GAIA* 33/3 (2024): 282–285
Keywords: collaborative spatial planning, research method, transdisciplinary research

Planning for more sustainable and resilient landscapes requires dealing with complexity – and the need to systematically involve diverse knowledge holders. Therefore, participatory planning approaches have been employed, typically involving discussion and co-design workshops. Geodesign was proposed in the 2000s as a new digitally based, spatially explicit approach to supporting planning that more tightly couples the power of Geographic Information Science (GIS) to assess complex data with design activities as a cycle of drafting, assessing, and revising, in a workshop setting. Geodesign has been used for a range of planning purposes and scales, including planning for climate change adaptation (Eikelboom and Janssen 2015), riverine nature-based solutions (Gottwald et al. 2021b) (box 1, p. 284), cultural landscapes (Ducci et al. 2023), and waste management (Arciniegas et al. 2019).

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**.

Geodesign enables participants to map or locate ideas and opinions on a digital map and thus translate them into specific spatial information. It is characterized by the interaction of its four key components (based on Steinitz' framework): 1. place-based local knowledge, values and preferences held by "the people of the place", deliberated during and/or assessed prior to the workshop (Gottwald et al. 2021a), and provided as or translated into spatial input; 2. design, planning, and decision-making expertise and interests by participants from "design professions" (planners, land managers, etc.), which are deliberated in the workshop process; 3. geographic sciences, which provide the scientific theoretical and methodological competencies in the process, for example the integration of systems perspectives and geographic context through value maps; and 4. information technology, which supports the process through hardware, such as touch interfaces, or software, such as specific GIS applications (Steinitz 2012). This makes the approach collaborative, multidisciplinary, and evidence-based (Debnath et al. 2022) with the aim to develop and explore spatial development alternatives, and a suitable tool for transdisciplinary research, able to manage boundaries,

Dr. Sarah Gottwald (corresponding author) | Leuphana University Lüneburg | Social-Ecological Systems Insitute | Lüneburg | DE | sarah.gottwald@leuphana.de

Prof. Dr. Christian Albert | Leibniz University Hannover | Institute of Environmental Planning | Hannover | DE | albert@umwelt.uni-hannover.de

Dr. Gustavo Arciniegas | Geo-Col GIS and collaborative planning | Delft | NL | geocolconsultant@gmail.com

Dr. Marta Ducci | Vrije Universiteit Amsterdam | Institute for Heritage Studies | Amsterdam | NL | mducci.vu@gmail.com

Sana Jajeh | Leibniz University Hannover | Hannover | DE

Dr. Ron Janssen | Vrije Universiteit Amsterdam | Institute for Spatial Economics | Amsterdam | NL | ronjanssen@live.com

Rory Taylor | University of Helsinki | Human-nature Transformations research group | Helsinki | FI | rory.taylor@helsinki.fi

https://doi.org/10.14512/gaia.33.3.10
Received May 17, 2024; revised version accepted August 22, 2024 (double-blind peer review).

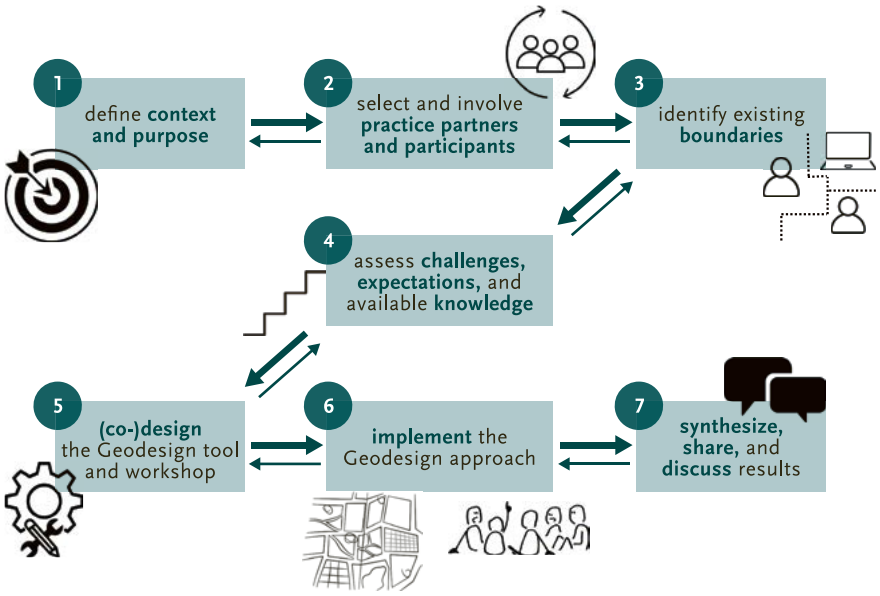


FIGURE 1: Iterative cycle of planning and implementing Geodesign processes.

for example between interest groups, knowledge frameworks, or people and technology (Gottwald et al. 2021 b). Within a (spatial) planning process, Geodesign has great potential in the scoping phase to facilitate problem characterization and early citizen involvement through integration with other participatory GIS tools (such as *Maptionnaire,* a mapping survey tool), in the design of actions and (spatial) measures, and in the assessment of potential impacts of proposed interventions.

Procedure

Collaborative Geodesign processes follow seven iterative steps (figure 1), ideally within in a transdisciplinary project design:

1 ***Define context and purpose:*** Depending on the setting (transdisciplinary or classical research design), researchers (in collaboration with practice partners) need to define the spatial scale, the thematic context and the purpose of the study. This will influence the data to be collected and managed, and the spatial scale(s) to be used.

2 ***Select and involve practice partners and participants:*** Depending on the (joint) definition of context and purpose, participants are invited to the process. The criteria for involvement should be in line with the context and purpose (step 1) and allow for credible, salient and legitimate processes and results. Geodesign mediates between different interests because it enables participants to be very specific and place based in their contributions. However, despite Geodesign's ability to facilitate debates about alternative future development, it always requires the willingness of participants to work together despite of differing interests and priorities.

3 ***Identify existing boundaries:*** This is an ongoing process, as boundaries may become visible or emerge during the process. To identify them, all human and nonhuman actors need to be considered, such as participants/practice partners, researchers, and technology, bearing in mind that these are not homogenous groups either. This also includes deciding on the spatial boundaries of the study area.

4 ***Assess challenges, expectations, and available knowledge:*** The key challenges of the study area need to be identified through an open and inclusive process of reviewing past documents, talking to key informants and representatives of key stakeholder groups. Available knowledge on the origins of the challenges, the evolution of actions to address them and existing ideas for the future should be compiled and assessed. Expectations of both the Geodesign team and their potential audiences should be elicited and harmonized. Finally, the Geodesign team should seek a mandate from a legitimate decision-making body, ensuring that there is an agreed-upon process for how the results can be taken into account in subsequent decision-making processes.

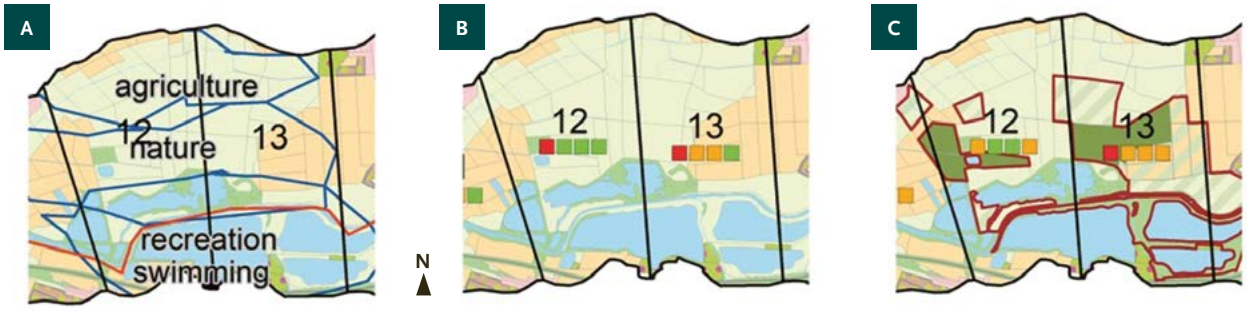
5 ***(Co-)design the Geodesign tool and workshop(s):*** This involves the selection for hardware, software, meeting format, specific workshop methods, data, and optional impact simulation. Workshops can be conducted using touch tables, projectors, laptops, tablets, or mobile phones, or a combination of these (handheld) devices and projected screens. There are tools and software specifically developed for Geodesign processes, such as *Geodesign hub, CommunityViz,* or *Geoplanner.* In addition to the application in face-to-face workshops, Geodesign processes can be carried out remotely using browser-based applications (Schröter et al. 2023). The format of the meeting (online or face-to-face, duration, number of workshops) is determined by the specific method, for example scenario planning, but also by practical considerations, such as availability of participants, or by research resources. Finally, a great potential of Geodesign is the possibility to simulate impacts during the workshop. This entails the (co-) selection of indicators, model building and implementation.

6 ***Implement the Geodesign process in one or more workshops:*** Many Geodesign studies refer to Steinitz's framework for Geodesign, which consists of six guiding questions answered by corresponding models: 1. How should the study area be described? (representation models); 2. How does the study area work? (process models); 3. Is the current study area working well? (evaluation models); 4. How could the study area be changed? (change models); 5. What differences might the changes cause? >

BOX 1: Using Geodesign as a boundary management process for planning nature-based solutions in river landscapes

Planning with nature-based solutions (NBS) responds to changing river management towards more nature-based or green infrastructure and solutions, and stronger integration of local citizens' values through participatory processes and innovative governance models. In this case, the Geodesign process facilitated participatory planning, management of boundaries between participants, and impacts assessment of NBS. In a one-day workshop (figure 2), eleven stakeholders delineated priority areas, changed land uses, and observed resulting impacts on ecosystem service indicators (climate regulation, pollination, nature-based recreation, food provisioning). The aim of the workshop was to jointly develop spatial scenarios for NBS in riverine landscapes. Participants had to recapitulate scenario stories developed in a previous workshop, sketch scenarios (figure 3 **A**), change land uses and explore impacts (figures 3 **B**, **C**), and finally reflect on the challenges and opportunities of Geodesign for river landscape planning. Therefore, three tools were implemented along these tasks – drawing and writing, land use change, and impact evaluation. Results include spatial NBS scenarios and insights into contributions to boundary management: 1. scenario stories were successfully, translated into spatial NBS scenarios; 2. the process facilitated fruitful discussion and was perceived as useful for communication; 3. however, mediation using a more complex indicator tool led to frustration and a decrease in trust (Gottwald et al. 2021 b).

FIGURE 2: Geodesign workshop with touch table.



climate regulation	pollination	recreation	food provision
0.93–1.66	1.00–1.66	1.00–1.66	1.00–1.66
1.67–2.32	1.67–2.32	1.67–2.32	1.67–2.32
2.33–3.00	2.33–3.00	2.33–3.00	2.33–3.00

FIGURE 3: Example: **A** scenario sketching: participants outlined priority areas and indicated respective priorities, for example agriculture, nature, recreation; different outline colours indicate different groups using touch table; **B** land use before change with indicators representing climate regulation, pollination, recreation, and food provision (squares, from left to right), traffic lights indicate the quality of the indicator between good (green) and poor (red), thresholds based on equal interval; indicator values refer to river segment (black outline); **C** changed land uses are outlined in red; changes could be realized per land use parcel, each parcel could be changed in any given land use, indicator values changed accordingly (per river segment), for example, in segment 12, climate regulation improved (orange to red) and food provision changed from green to orange after grassland was converted to forest. The striped areas indicate extensive land uses. For detailed explanation see Gottwald et al. (2021 b).

(impact models); and 6. How should the study area be changed? (decision models). The six questions are addressed in three iterations: understanding the context, determining the methods, and only then conducting the study. While this framework has been instrumental in advancing Geodesign, not all applications strictly follow each of its steps. Nor is Geodesign always collaborative, with many studies taking a purely computational approach (Debnath et al. 2022).

7 ***Synthesize, share, and discuss results with audience:*** Finally, the substantive results of the Geodesign exercise need to be conveyed to the respective audiences in formats that allow them to understand the study's assumptions, the spatial development options and their likely impacts. Where possible, the results should be delivered in a manner suitable for subsequent monitoring and follow-up studies. Uptake can be fostered by complementing the Geodesign exercise with an inclusive process of decision-making and co-designing an adaptive implementation strategy.

Skills and resources needed

We need to distinguish between workshop participants, who are decision-makers, planners, and affected citizens, and workshop organizers, who are usually researchers and facilitators.

Participants in Geodesign workshops need some basic map literacy (reading and drawing), but also some digital literacy, which of course becomes even more important in virtual workshop settings. They should also be open to and appreciate teamwork and deliberative processes in which they share their knowledge and listen to and work with the knowledge (systems) and ideas of others. The Geodesign process should be considered as a credible, salient, and legitimate contribution to addressing local challenges (Gottwald et al. 2021b). This would allow time and knowledge resources to be allocated to the process.

Organizers need to invest in software licenses (unless open source software is used), hardware (e.g., computers, touch interfaces), data, and workshop logistics. Researchers need to have a deep understanding of the development and challenges of the study area. They need to bring skills in tool development and design, GIS and map-making (intermediate to advanced depending on the complexity of the tool and the spatial analysis being undertaken), data curation and management, understanding and conducting iterative processes, and facilitation skills. Of course, specific skills can be outsourced to external experts.

Strengths and weaknesses

Strengths and benefits

Geodesign workshops function as boundary management processes, that is, they enable translation and mediation between different interests and knowledge frames. Implicit knowledge and visions are revealed by translating verbal communication into spatially explicit statements that are visualized on a geographic map and serve as the main negotiation language. Maps are a basic tool for planners and decision-makers, thus results can be easily communicated and integrated into practice, providing simplified visualizations of complex realities.

Geodesign enables the co-development of new ideas and spatial visions, as well as the identification of potential spatial conflicts and the negotiation of synergistic solutions. During the workshops, spatial information is available as map layers that can be retrieved on demand. The process is iterative, allowing changes to be responded to. Digital maps enable to work cross-scale: by zooming in and out, participants can interact with specific issues at various scales. Finally, different mapping methods can be integrated to combine, for example, instrumental assessment from mapping surveys with deliberative Geodesign processes, which provides another layer of local knowledge and perceptions to the design process (Gottwald et al. 2021a).

Weaknesses and challenges

The ***potential costs of software, hardware, and data collection, as well as the (time) resources for preparation (especially, if impact models are used) and analysis*** can be a weakness of the process. However, this depends on the number of workshops and thus the results, output, and impact of the process.

Furthermore, the ***lack of a clear definition*** may inhibit the development of the process, and its evaluation and comparability. Most Geodesign processes (studies published in scientific journals) lack collaboration with practice partners and/or the local population, but rather focus on computer simulations (Debnath et al. 2022). At this stage of Geodesign studies, we need more real-world applications that involve practice partners and local population not only during workshop(s), but also in the co-development of the tool, process, and models.

Finally, while the Geodesign process provides a good framework for modelling and depicting collaboration between actors along the decision-making process, it does ***require good facilitation and negotiation skills on the part of workshop leaders and participants.*** Many decisions need to be made in short spurts of time. This can make joint designs difficult for certain types of actors with highly conflicting objectives.

Acknowledgements: The authors would like to thank two reviewers for the helpful comments.
Funding: This work was funded by the German Research Foundation (DFG) (grant number 465127621).
Competing interests: The authors declare no competing interests.
Authors' contributions: *SG:* initial research design; *SG, CA, GA, MD, SJ, RJ, RT:* manuscript drafting; *SG,CA:* writing the final manuscript.

References

Arciniegas, G. et al. 2019. A geodesign decision support environment for integrating management of resource flows in spatial planning. *Urban Planning* 4/3: 32–51. https://doi.org/10.17645/up.v4i3.2173.
Debnath, R., C. Pettit, S. Z. Leao. 2022. Geodesign approaches to city resilience planning: A systematic review. *Sustainability* 14/2: 938. https://doi.org/10.3390/su14020938.
Ducci, M., R. Janssen, G. J. Burgers, F. Rotondo. 2023. Co-design workshops for cultural landscape planning. *Landscape Research* 48/7: 900–916. https://doi.org/10.1080/01426397.2023.2204222.
Eikelboom, T., R. Janssen. 2015. Collaborative use of geodesign tools to support decision-making on adaptation to climate change. *Mitigation and Adaptation Strategies for Global Change* 22/2: 247–266. https://doi.org/10.1007/s11027-015-9633-4.
Gottwald, S., J. Brenner, C. Albert, R. Janssen. 2021a. Integrating sense of place into participatory landscape planning: Merging mapping surveys and geodesign workshops. *Landscape Research* 46/8: 1041–1056. https://doi.org/10.1080/01426397.2021.1939288.
Gottwald, S., J. Brenner, R. Janssen, C. Albert. 2021b. Using Geodesign as a boundary management process for planning nature-based solutions in river landscapes. *Ambio* 50/8: 1477–1496. https://doi.org/10.1007/s13280-021-01592-0.
Schröter, B., S. Gottwald, K. Castro-Arce, E. Hartkopf, B. Aguilar-González, C. Albert. 2023. Virtual participatory mapping of nature-based solutions in the Grande de Tárcoles River basin, Costa Rica: Connecting diverse knowledge systems in a context of physical immobility. *Science of the Total Environment* 872: 162195. https://doi.org/10.1016/j.scitotenv.2023.162195.
Steinitz, C. 2012. *A framework for geodesign: Changing geography by design.* Redlands, CA: Esri.