

Sense of Place in Spatial Planning: Applying Instrumental and Deliberative Approaches at the River Lahn

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Dissertation

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The drawing on the title page shows the Lahn river in Gießen, place of birth and Heimat of one of the participants of the PPGIS study and her already deceased brother. He drew the picture during his service for the French Foreign Legion. She sent a copy of this drawing wrote the following lines in reaction to the survey invitation “[...] *Why do I write all of it? To show you how a young person was attached to his Heimat = Giessen – Lahn! From Africa and Indochina [now mainland southeast Asia] this one – and many more – drawings arrived... Homesickness... [...]*” (M.F. 2017)

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Lüneburg, 20 November 2020

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Contents

LIST OF FIGURES	I
LIST OF TABLES	II
ABSTRACT	III
KURZFASSUNG	VII
CUMULATIVE THESIS.....	XI
ARTICLE I	XII
ARTICLE II.....	XIII
ARTICLE III	XIV
ARTICLE IV	XV
THESIS.....	1
1. INTRODUCTION	3
1.1 Background	3
1.2 Structure of the thesis	6
2. BACKGROUND AND CONCEPTS	9
2.1 River landscape planning and the role of citizens.....	9
2.1.1 River landscape planning and management	9
2.1.2 Participation in river landscape management and planning	11
2.2 The theory of sense of place and its integration into spatial planning.....	14
2.2.1 Grasping the theory of sense of place.....	14
2.2.2 Spatially assessing sense of place.....	16
2.2.3 Opportunities and challenges for integrating sense of place in spatial planning	18
2.3 Knowledge gaps	19
3. METHODOLOGY AND CASE	22
3.1 Research design and rationale.....	22

3.2	Research context and study area	24
3.2.1	Study area: Lahn river landscape	24
3.2.2	Transdisciplinary project	26
3.3	PPGIS method to assess sense of place	28
3.3.1	Data assessment methods: PPGIS survey and sampling	28
3.3.2	Data analysis	31
3.4	Geodesign workshop integrating sense of place	31
3.4.1	Set up of Geodesign workshop	32
3.4.2	Workshop data collection and evaluation	34
3.5	Limitations	34
4.	SYNTHESIS OF RESULTS AND DISCUSSION	36
4.1	A spatial indicator for the assessment of sense of place (<i>Articles I and II</i>)	37
4.2	Application of the meaningful place indicator (<i>Article II and III</i>)	39
4.2.1	Characterisation of meaningful places	40
4.2.2	Meaningful places and their relation to environmental stewardship	42
4.3	Integrating sense of place into participatory river landscape designs (<i>Article IV</i>)	46
4.3.1	Integrating sense of place into a Geodesign Workshop	46
4.3.2	Proposal of a participatory spatial planning concept for designing NBS in river landscapes – combining instrumental and deliberative approaches	49
5.	CONCLUSIONS	52
5.1	Contributions of this dissertation	52
5.2	Future research directions	55
	REFERENCES	59
	EIDESSTATTLICHE ERKLÄRUNG/ DECLARATION OF AUTHORSHIP	69
	APPENDIX	71

List of figures

Figure 1 Research structure	7
Figure 2 Illustration of sense of place, its sub concepts, and its relation to place-related behaviour or environmental stewardship (Masterson <i>et al.</i> 2017)	16
Figure 3 Study area with illustrative photographs (taken by author), <i>source: Gottwald et al, under review, Article II</i>	26
Figure 4 PPGIS survey interface, screenshot from https://app.maptionnaire.com/en/800/ , accessed 12.11.2020	29
Figure 5 Study area Geodesign workshop, <i>source: Gottwald et al., under review, Article IV</i>	32
Figure 6 Impression from Geodesign workshop, participants could use a pen or their finger to draw and write on the map, <i>source: Gottwald et al, under review, Article IV</i>	33
Figure 7 Conceptual framework, based on (Maes <i>et al.</i> 2016, Masterson <i>et al.</i> 2017), <i>source: Gottwald et al., under review, Article II</i>	38
Figure 8 Frequency of place meaning types, note: *based on free listed place meanings, +based on CES place meaning list, +* combination of both, <i>source: Gottwald et al., under review, Article II</i>	41
Figure 9 Distribution of action and no action places, the numbers show the amount of values encountered at each place (Gottwald and Stedman 2020), <i>source: Gottwald and Stedman 2020, Article III</i>	44
Figure 10 Relation between variables of sense of place, physical environment, personal attributes and environmental stewardship, Note: dashed line - relation only for respondents who are willing to take action at <i>all</i> of their located meaningful places	45
Figure 11 drawing, <i>source: Gottwald et al., under review, Article IV</i>	48
Figure 12 Model of landscape planning process, including contribution of sense of place and potential planning and assessment methods, based on (Von Haaren <i>et al.</i> 2008, Lange and Riedel 2016, von Haaren <i>et al.</i> 2016), <i>source: Gottwald et al., under review, Article IV</i>	51
Figure 13 Actionable advice for planners around using and integrating sense of place in planning processes	55

List of tables

Table 1. Assessed variables and variables used in the analysis, *assessed through PPGIS survey, ¹ source: Digital Basic Land-scape Model (2016) provided by Federal Agency for Cartography and Geodesy, ² source: Corine land use data (EU) 29

Table 2 Comparison of socio-demographic variables between self-select sample, random sample and census data, census data based on Hessian State Agency for Statistics, Wiesbaden, 2019 and 2020, NA=no answer, source: *Gottwald et al, under review, Article IV*..... 39

Abstract

Keywords: Sense of place; place meanings; place attachment; environmental stewardship; spatial planning; landscape planning; PPGIS; Geodesign

“[...] Why do I write all of it? To show you how a young person was attached to his Heimat = Giessen – Lahn! From Africa and Indochina [now mainland southeast Asia] this one – and many more – drawings arrived... Homesickness... [...]” (M.F. 2017). This quote from one of the citizens of the Lahn region is from a letter that arrived at my office, in response to our survey invitation on mapping meaningful places in the Lahn river landscape, the empirical research project of this dissertation, in a local newspaper in summer 2017. She sent a letter with these lines and a copy of her brother’s drawings (see title page). The quote epitomizes how deeply we humans are connected to the places we live in and even to the places that we used to live in, like in the case of her deceased brother. What he drew in his letters to her sister reflects his memory, his Heimat, his roots, while being at a place that is far away and most likely differs considerably in terms of topography, flora, fauna, climate, and sensory experiences, such as smell. His drawing represents his **sense of place**, his emotional attachment to the place he grew up, as she points out in the letter. His attachment is expressed and translated in this picture of the river Lahn, a bridge, a house, trees, and even a little peninsula with a bench on it. Maybe. Without asking the person directly, we can only speculate whether he used to sit there contemplating the scenery or being with friends and family, but are still able to draw conclusions on the specific place meanings through theories and empirical research.

In particular, the theory of sense of place helps us to assess and better understand place meanings and emotional connections between people and place. Visibly depicted in the brother’s drawing and letter, a person’s sense of place encompasses the emotional dimension of place attachment and the cognitive dimension of place meanings. Place attachments represent the intensity of the emotional connections to a place, and place meanings describe

in more detail the reasons for this connection. Both concepts are important to generate a holistic picture, because for example the woman who wrote me the letter with the drawings of her brother could share an equally strong attachment to this little peninsula with the bench at the Lahn, but for completely different reasons, assigning different meanings to the place. Or they could both associate similar meanings with it, such as relaxation or the enjoyment of the scenery, but one feels more intensely emotionally connected than the other. The example shows that social construction of the place is strongly connected to its actual biophysical characteristics of the place. To clarify, a river such as the Lahn allows for the creation of meanings associated with fishing. Therefore, a change of the landscape or its accessibility, such as straightening the part of the river and removing the peninsula and bench seen in the drawing, can impact the perceived place meanings, as well as the emotional attachment. Vice-versa, sense of place can have an influence on how people interact and shape the landscape, relating directly to their **environmental stewardship** behaviour, which refers to actions taken, direct (e.g. collecting garbage) or indirect (e.g. signing a petition) that have an impact on a specific geographic location. We may hypothesize that the brother or even his sister would have opposed any planning decision on removing that peninsula, because their sense of place would have been threatened, or even destroyed.

This illustrates how important the knowledge of the citizens' sense of place can be for planners and decision-makers. Therefore, the dissertation argues that the integration of sense of place into **planning processes** likely enhances understanding of impacts of change, minimises potential conflicts, strengthens environmental stewardship, and increases identification with the plan proposal. Yet, such integration is still lacking and underexplored. Three main shortcomings could be identified inhibiting the use of sense of place in planning practices. First, there is a myriad of overlapping and conflicting terminologies and conceptualizations, including sense of place, place attachment, place identity, place dependence and so forth. This leads to a lack of comparability and the risk of oversimplification when working with sense of place and neglecting its sub concepts of place attachment and meanings. Second, there is a shortcoming of spatially explicit assessment methods, which would fit well in planning processes that use spatial indicators in their landscape assessments. There are very few examples that have spatially assessed sense of place including the sub concepts of place attachment and meanings. Existing spatial assessments on sense of place tend to rely on predefined spatial delimitations, such as administrative boundaries of neighbourhoods or national parks, which

do not represent the actual exposure of an individual to its environment. Third and in consequence of the other two shortcomings, there is a lack of guiding material for planners on how to assess and implement sense of place in practice.

Therefore, this dissertation aims to explore a systematic integration of sense of place into spatial and landscape planning. This is done following four guiding objectives:

- (1) Develop and evaluate a spatial indicator for the assessment of sense of place to enhance the systematic integration of sense of place into spatial planning (*Article I and II*)
- (2) Apply the indicator to assess sense of place of citizens in a case study area (*Article II*)
- (3) Explore the relationship between sense of place and environmental stewardship as an alternative to traditional planning practice (*Article III*)
- (4) Integrate sense of place into a planning workshop and derive suggestion for integrating sense of place into landscape planning practice (*Article IV*)

To empirically address these research objectives, at first, a Public Participation GIS (**PPGIS**) method is used to assess meaningful places in the Lahn river landscape. In a PPGIS survey, respondents were able to locate meaningful places on a map and respond more detailed questions on that place in relation to the specific place meaning, attachment and environmental stewardship. There are abundant examples of the use of PPGIS for the assessment of spatial values, landscape values or cultural ecosystem services. Secondly, the information on meaningful places was then integrated into a **Geodesign** workshop with stakeholder responsible for administrating the river and its landscape on different spatial scales. Geodesign is a deliberative approaches of social value assessment, which is based on geographic information and communication.

The dissertations' results show that the proposed meaningful place indicator to spatially assess sense of place (*Article I and II*) is valid, measurable, transferable and of practical relevance (*Article I*). It further demonstrates methodological and theoretical synergies between sense of place and the related people-place relation concept of cultural ecosystem services (*Article II*). Furthermore, *Articles II and III* empirically reveal the central role of place

meanings in relation to the social and environmental context, as well as to environmental stewardship. Moreover, the integration of meaningful place information in a Geodesign workshop has shown to spur discussion, cover local knowledge gaps and be of interest and professional relevance. Finally, the dissertation provides a proposal of how, where and with what potential benefits sense of place can be integrated into landscape planning (*Article IV*).

Kurzfassung

Schlagwörter: Ortsverbundenheit; Ortsbedeutung; Landschaftsplanung, Raumplanung, PPGIS; Geodesign

„[...] Warum schreibe ich das alles? Um Ihnen zu zeigen, wie ein junger Mensch an seiner Heimat = Giessen – Lahn hing! Aus Afrika oder Indochina [heute Südostasiatisches Festland] kamen diese - und mehr – Zeichnungen... Heimweh... [...]“ (M.F. 2017). Dies ist das Zitat einer Bewohnerin der Lahn Region, welche die Einladung zu einer Umfrage in der lokalen Zeitung sah, in welcher bedeutende Orte auf einer Karte eingetragen werden sollten. Sie schrieb mir die obigen Zeilen und schickte dazu die Kopie einer Zeichnung ihres Bruders (siehe Titelseite). Am Beispiel des Bruders wird deutlich, wie tief wir mit Orten verbunden sind, an denen wir leben oder gelebt haben. Die Zeichnung spiegelt seine Erinnerung wieder, seine Heimat, seine Wurzeln, während er sich an einem weit entfernten Ort aufhielt, der sich wahrscheinlich stark in Topographie, Flora, Fauna, Klima und sensorischen Eindrücken, wie den Gerüchen, von seiner Heimat Gießen unterschied. Er stellt seinen ganz individuellen *sense of place* dar, d.h. seine emotionale Verbindung zu dem Ort, an dem er aufwuchs, wie aus dem Brief der Schwester hervorgeht. Die Zeichnung zeigt eine Brücke über die Lahn, ein großes Haus, mehrere Bäume, sowie eine kleine Halbinsel mit einer Sitzbank. Ohne ihn direkt zu fragen, können wir nur spekulieren ob er auf dieser Bank gesessen hat, um die Aussicht zu genießen oder um mit seiner Familie und seinen Freunden zusammen zu sein, aber wir können dennoch unsere Schlüsse dazu ziehen mithilfe von Theorien und empirischer Forschung.

Die Theorie von *sense of place* hilft uns die Verbindung von Mensch, wie dem Bruder, und Ort zu erfassen und zu verstehen. Es besteht aus einer emotionalen Ebene, der Ortsverbundenheit (*place attachment*), und einer kognitiven Ebene, der Ortsbedeutung (*place meaning*). Ortsverbundenheit stellt die Intensität der emotionalen Beziehung zum Raum dar, während Ortsbedeutung die spezifischen Gründe für diese Beziehung beschreibt. Beide Ebenen sind für ein

ganzheitliches Verständnis von Mensch-Ort Beziehungen wichtig, da sie ganz unterschiedlich ausgeprägt sein können. Zum Beispiel, könnte die Frau, die uns den Brief geschrieben hat, mit der auf der Zeichnung dargestellte Halbinsel mit Bank eine ganz andere Bedeutung verbinden als ihr Bruder, obwohl beide sich emotional ähnlich stark dort verbunden fühlen. Oder beide assoziieren eine ähnliche Bedeutung mit diesem Ort, wie zum Beispiel Entspannung auf der Bank sitzen, aber fühlen sich unterschiedlich stark dazu verbunden. Die soziale Konstruktion von Orten ist jedoch auch stark an die tatsächliche physische Beschaffenheit des Raums geknüpft. Ein Fluss, wie die Lahn, ermöglicht, zum Beispiel, die Bedeutungszuweisung von Fischen oder Angeln. Daher kann eine Veränderung der Landschaft oder auch ihrer Zugänglichkeit, wie z.B. die Begradigung des Flusses und damit einhergehende Entfernung der Halbinsel mit Bank, eine Veränderung der wahrgenommen Ortsbedeutungen nach sich ziehen und die Verbundenheit zum jeweiligen Ort beeinflussen. Gleichzeitig beeinflusst der *sense of place* auch, wie Menschen mit ihrer Umwelt interagieren und die Landschaft formen, da dieser direkt mit Umweltverantwortung (*environmental stewardship*) und entsprechendem verbunden ist. Dieses Verhalten bezieht sich auf direkte Handlungen (z.B. das Entfernen von Müll) oder indirekte Handlungen (z.B. das Unterschreiben einer Petition), welche eine unmittelbare ortsspezifische Auswirkung haben. Wir können also hypothetisieren, dass der Bruder und vielleicht sogar seine Schwester sich einer Planungsentscheidung zum Entfernen der Halbinsel, die auf der Zeichnung zu sehen ist, entgegengestellt hätten, weil ihr *sense of place* bedroht wäre.

Die Einbindung von *sense of place* in die Raum- und Landschaftsplanung bietet daher viele Vorteile: Das Wissen von Ortsbedeutung und -verbundenheit kann im Prozess berücksichtigt werden, und durch Veränderungen in der Landschaft kann die Entwicklung neuer Bedeutungen ermöglicht werden. Die Einbindung unterstützt die konsensorientierte Planung, da potentielle Konflikte, zum Beispiel durch einen Eingriff in Orte mit hoher Verbundenheit, frühzeitig erkannt und bearbeitet werden können. Die Intensität der Ortsverbundenheit steht in direktem Zusammenhang zu Umweltverantwortungsverhalten oder auch oppositionellem Handeln gegenüber neuen Projekten. Letztlich unterstützt die Einbindung von *sense of place* auch einen integrativen Planungsanspruch, da die Bereitschaft zur Partizipation und Kooperation im Planungsprozess bei einer starken emotionalen Beziehung zum Raum stärker ausgeprägt sind.

In der Planungspraxis findet jedoch bisher keine systematische Einbindung von *sense of place* statt. Drei Hauptursachen können dafür ausgemacht werden: Erstens werden eine Vielzahl von Begriffen und Konzepten, ähnlich zu *sense of place*, inkohärent verwendet. Das führt zu einer schwierigeren Vergleichbarkeit bestehender Studien und Erkenntnisse und zu dem Risiko der Vereinfachung des *sense of place* Begriffs, wenn beispielsweise die Unterkonzepte der Ortsbedeutung und -verbundenheit nicht berücksichtigt werden. Zweitens gibt es kaum räumlich explizite Erhebungsverfahren, welche vergleichbar zu biophysikalischen Indikatoren in die bestehende Praxis der Landschaftserfassung integriert werden könnten. Erfassungsmethoden orientieren sich meist an vordefinierten räumlichen Grenzen, wie zum Beispiel administrative Abgrenzungen von Stadtteilen oder Nationalparks. Diese Abgrenzungen repräsentieren allerdings in vielen Fällen nicht den physischen Raum, in dem der tatsächliche Austausch eines Individuums mit seiner Umwelt stattfindet. In Konsequenz der zwei zuvor genannten Ursachen, ergibt sich als dritte Ursache, dass es an einer konkreten Anleitung für LandschaftsplanerInnen und MangerInnen zur Erhebung und Integration von *sense of place* in Planungsprozesse fehlt.

Daher ist das Ziel dieser Dissertation, die systematische Integration von *sense of place* in der Raum- und Landschaftsplanung zu untersuchen. Dies ist von folgenden vier Unterzielen geleitet:

- (1) Die Entwicklung und Bewertung eines räumlichen Indikators zur Erhebung von *sense of place* für die Raum- und Landschaftsplanung (*Artikel I und II*)
- (2) Die Anwendung des Indikators, um *sense of place* der lokalen Bevölkerung in einem konkreten Studiengebiet zu erheben (*Artikel II*)
- (3) Die Untersuchung der Beziehung zwischen *sense of place* und Umweltverantwortungsverhalten (*Artikel III*),
- (4) Die Einbindung von *sense of place* Informationen in einen Planungsworkshop und die Ableitung und Empfehlung zur konkreten Integration von *sense of place* in Planungsprozesse (*Artikel IV*)

Um dies zu erfüllen, wurden zunächst in einer GIS-basierte Umfrage (PPGIS) bedeutende Orte an der Lahn erhoben. Teilnehmende konnten ihre bedeutenden Orte auf einer Karte markieren und wurden aufgefordert detaillierte Fragen zu Ortsbedeutung, -verbundenheit und

Umweltverantwortung in Bezug zu den markierten Orten zu beantworten. PPGIS ist eine vielgenutzte Methode zur Erhebung räumlicher Werte, wie zum Beispiel Landschaftswerte oder auch kulturelle Ökosystemleistungen. Die durch die Umfrage erhobenen Informationen zu den bedeutenden Orten wurden in einen Geodesign Workshop integriert, an dem Akteure des Fluss- und Flusslandschaftsmanagements teilnahmen. Geodesign ist ein deliberativer Ansatz, welcher auf Geoinformation und Kommunikation basiert.

Die Ergebnisse der Dissertation zeigen, dass der entwickelte Indikator zur räumlichen Erhebung von *sense of place* (Artikel I und II) valide, messbar, übertragbar und relevant ist (Artikel I). Darüber hinaus konnten anhand des Indikators die methodischen und theoretischen Synergien zwischen *sense of place* und dem verwandten Konzept der kulturellen Ökosystemleistungen aufgezeigt werden (Artikel II). Artikel II und III demonstrieren die zentrale Rolle von Ortsbindungen in Beziehung zum physischen Raum und persönlichen Attributen, sowie zur Umweltverantwortung. Ferner hat die Einbindung von *sense of place* im Geodesign Workshop zu einer regen Diskussion beigetragen, lokale Wissenslücken gefüllt und sie wurde als interessant und relevant von der Mehrzahl der Akteure bewertet (Artikel IV). Schließlich gibt diese Dissertation konkrete Vorschläge, wie, wo und mit welchen potentiellen Vorteilen *sense of place* in einem Landschaftsplanungsprozess integriert werden kann (Artikel IV).

Cumulative Thesis

This cumulative dissertation is based on the following four scientific articles: I) Using Meaningful Places as an Indicator for Sense of Place in Spatial Planning, II) Combining sense of place theory with the ecosystem services concept – empirical insights and reflections from a participatory mapping study, III) Preserving ones meaningful place or not? Understanding environmental stewardship behaviour in river landscapes, and IV) Integrating sense of place into participatory landscape planning– merging mapping surveys and Geodesign workshops . They are referred to in the text in Roman numerals. At the time of the thesis' submission one of them has already been published (III), two are under review (I, II) and one is submitted (IV). The articles are included in the appendix.

Article I

Title: Using Meaningful Places as an Indicator for Sense of Place in Spatial Planning

Authors: Knaps, F., **Gottwald, S.**, Hermann, S., Albert, C.

Submitted to: Ecological Indicator (Mai 2020)

Summary:

Sense of place is a recognized and promising theory to assess people's relationship to the environment. It accounts of the subjective perspective within social-ecological systems research and acknowledges that landscapes and its dynamics are perceived by people. However, it has shown to fall short in planning literature and little is known about approaches to operationalize the concept for the practice of spatial planning. They can be explained with a myriad of conceptual understandings, resulting assessment methods and a lack of recommendations on its integration into planning processes. Therefore, this article proposes a spatial indicator for the assessment of sense of place, namely 'meaningful place indicator'. The indicator is applied in two case studies and evaluated using benchmarks of environmental indicators. Results showed that the indicator is measurable (using for example a PPGIS survey and interviews in combination with mapping exercises), transferable to different spatial scales and local and planning contexts. The article provides a first claim in combination with specific suggestion for an integration of sense of place in spatial planning practice.

Author's contribution:

The co-author S. Gottwald developed together with the first author the main idea and structure of the article, and was substantially involved in writing the article in collaboration with the first author. The article is based on two case studies, of which one was led, analysed and written by S. Gottwald. The other co-authors provided scholarly advice.

Article II

Title: Combining sense of place theory with the ecosystem services concept – empirical insights and reflections from a participatory mapping study

Authors: **Gottwald, S.**, Fagerholm, N., Albert C.

Submitted to: Landscape Ecology (Oct 2020)

Summary:

River landscapes are rich in biodiversity and offer diverse ecosystem services to people. River landscape and their dynamics are subjectively perceived, yet little is known on the emotional connections people create to those landscapes. The theory of sense of place and the concept of cultural ecosystem services (CES) offer methodological and conceptual approaches to fill this gap and assess people-place relationships. Employing a spatial meaningful place indicator, this study aimed to assess people-place relations in a river landscape using sense of place theory and the CES concept. In an innovative way, free listed place meanings were combined with place meanings based on an established list of CES. Relationships between place meanings, attachment, biophysical and personal attribute variables were assessed using statistical analysis, such as Spearman's Rank correlation and one-way Anova analysis. Findings show that place meanings are crucial to understand the relation between sense of place and the social and environmental context. Further, the combination of free-listed and CES meanings highlighted that mainly meanings related to forms and practices are reflected with the CES list, but relationship meanings, such as Heimat or memories are overlooked. Finally, we propose the combination of sense of place theory and CES concept as useful as the latter offer methodological expertise in spatial quantitative assessment, while sense of place provide theoretical depth of the understanding of people-place relationships.

Author's contribution:

The first author, S. Gottwald led the assessment and analysis of the data. She undertook the conceptualization of the article and the overall writing process. The co-authors gave meaningful consultation in the analysis method provided scholarly advice.

Article III

Title: Preserving ones meaningful place or not? Understanding environmental stewardship behaviour in river landscapes

Authors: **Gottwald, S.**, Stedman, R.C.

Published in: *Landscape and Urban Planning*, 198, 103778, Feb 2020

DOI: 10.1016/j.landurbplan.2020.103778

Summary:

Landscapes are rapidly changing due to climate change and globalization processes. These complex and dynamic changes require innovative forms of governance. Environmental stewardship offers a promising approach, with a focus on people as agents of change and action. The aim of this study was to explore the relation between environmental stewardship and people-place relationships, specifically sense of place, as well as biophysical and personal attributes. It used a Public Participation GIS (PPGIS) method to assess meaningful places from local citizens at the Lahn river landscape. Descriptive statistics, bivariate correlation analysis and regression modelling was employed. Results show that environmental stewardship was mainly a function of sense of place and a person's capacity to act. Further, if people were willing to act as environmental stewards at all their located meaningful places, besides sense of place, local knowledge and environmental citizenship are the most significant predictors. Yet, if people were willing to act at only some of their located meaningful places, sense of place was the only significant predictor. Showing a strong relation between sense of place and environmental stewardship, we argue for a stronger integration of sense of place into planning practice, providing spatially explicit information on penitential resistance of future planning, and a resource for potential collaboration with the public.

Author's contribution:

The first author, S. Gottwald is responsible for the conceptualization and writing under supervision of the co-author. The co-author gave substantial support in the conceptualization and methodology, as well as review and editing of writing.

Article IV

Title: Integrating sense of place into participatory landscape planning– merging mapping surveys and Geodesign workshops

Authors: **Gottwald, S.**, Brenner, J., Albert, C., Janssen, R.

Submitted to: Landscape Research (Nov 2020)

Summary:

The article presents a proposal for the integration of sense of place into landscape planning processes. A specific case study illustrates how spatial information on sense of place assessed using an instrumental approach can be integrated into a deliberative Geodesign process with planning administration stakeholders. We found that sense of place information spatially located by local citizens revealed partly unexpected spatial location of meaningful places and were a useful complementation to local knowledge within the workshop. Furthermore, sense of place information spurred discussion on potential place meanings. Finally, the information was considered interesting and useful for their own work by the workshop participants. Therefore, we advocate for a consideration of sense of place in participatory planning process to integrate citizens' emotional connection to the landscape.

Author's contribution:

The first author, S. Gottwald is responsible for the conceptualization and wrote most of the article. The co-authors contributed with scholarly advice, and written contributions to parts of the result section and discussion section.

Additional articles and book chapter written during the course of my doctorate

I co-authored eight additional manuscripts submitted or accepted for publication during the course of my time as a doctoral student:

Article/ Chapter	Reference	Publication status
V Book chapter	Gottwald, S., Janssen, R., & Raymond, C. (2020). Can Geodesign Be Used to Facilitate Boundary Management for Planning and Implementation of Nature-based Solutions? In <i>Modelling Nature-based Solutions</i> (pp. 305–340). Cambridge University Press. https://doi.org/10.1017/9781108553827.010	published
VI	Gottwald S., Brenner J., Janssen R., Albert C. (2020): Geodesign in planning with nature-based solutions: exploring outputs and boundary management contributions. <i>AMBIO</i> , https://doi.org/10.1007/s13280-020-01435-4	accepted
VII	Verbrugge, L., Buchecker, M., Garcia, X., Gottwald, S., Müller, S., Præstholm, S., & Stahl Olafsson, A. (2019). Integrating sense of place in planning and management of multifunctional river landscapes: experiences from five European case studies. <i>Sustainability Science</i> , 14(3), 669–680. https://doi.org/10.1007/s11625-019-00686-9	published
VIII	Garcia, X., Gottwald, S., Benages-Albert, M., Pavón, D., Ribas, A., & Vall-Casas, P. (2020). Evaluating a web-based PPGIS for the rehabilitation of urban riparian corridors. <i>Applied Geography</i> , 125, 102341. https://doi.org/10.1016/j.apgeog.2020.102341	published
IX Book chapter	Raymond C., Gottwald S. (under review): Beyond the 'local': methods for examining place attachment across geographic scales.- In: Manzo L, Devine-Wright P (Editors): <i>Place attachment – advances in Theory and Methods</i> , 2 nd Eds.	accepted
X	Röing, S., Gottwald, S., Hermes, J., Schmidt, S., Albert, C. (under review). Spatially assessing unpleasant places with hard- and soft-GIS methods: a river landscape application. Submitted to: <i>Ecosystems and People</i>	under review
XI	Albert, C., Schröter, B., Haase, D., Brillinger, M., Henze, J., Herrmann, S., Gottwald, S., Guerrero, P., Nicolas, C., & Matzdorf, B. (2019). Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute? <i>Landscape and Urban Planning</i> , 182(September 2018), 12–21. https://doi.org/10.1016/j.landurbplan.2018.10.003	published
XII	Albert, C., Brillinger, M., Guerrero, P., Gottwald, S., Henze, J., Schmidt, S., Ott, E., & Schröter, B. (2020). Planning nature-based solutions: Principles, steps, and insights. <i>Ambio</i> . https://doi.org/10.1007/s13280-020-01365-1	published

Thesis

1. Introduction

1.1 Background

River landscapes are complex social-ecological systems which offer a wide range of amenities and services to people. These include recreation, fresh water provision, and carbon sequestration (Vermaat et al., 2015). Thiele et al. (2019) have shown that river landscapes are characterized by higher landscape aesthetic quality than other landscape types in Germany. River landscapes are also a hotspot for biodiversity (Dudgeon et al., 2006). Moreover, river landscapes embody close linkages between cultural and biophysical dynamics, for example, when adapting management to hydrological fluctuation (Wantzen et al., 2016). However, many rivers worldwide are in peril, impacting both biodiversity and human lives (Vörösmarty et al., 2010). Since the start of the 20th century two third of German flood plains disappeared (BMUB and BfN, 2009) and only around 40% of the European rivers are in a good or high ecological conditions (EEA, 2018). Rivers and river landscapes face complex challenges, such as climate change or loss of biodiversity (WBGU, 2011), which are subjectively perceived and interpreted (Davidson, 2010) by people who live in, depend on, and shape these landscapes. Their backgrounds, abilities, cultural settings, and power relations influence their understanding of, and interest in, land-use changes (Stedman, 2016). Yet, there is a lack of understanding how people feel emotionally attached to rivers (Verbrugge et al., 2019, *Article VII*).

Sense of place has been proposed as a valuable approach to assess and understand the subjective relation between people and place for environmental management (Hausmann et al., 2016; Masterson et al., 2017; Stedman, 2016) and specifically in river landscapes (Verbrugge et al., 2019). This study draws on the definition by Tuan describing sense of place as the meanings and attachments people or groups attribute to place (Tuan, 1977). Place attachments are of evaluative character, representing intensity and dimensions of the emotional connections to a place, while place meanings describe in more detail the reasons for this connection (Masterson et al., 2017; Stedman, 2016). The

process of formation of sense of place is influenced by individual people's and place attributes (Raymond et al., 2017b). Therefore, sense of place can be subject to changes in a landscape. For example, place attachment showed negative correlation with expected benefits of dam constructions in a Dutch river (Ganzevoort and van den Born, 2018). Other studies highlight the strong role of place meanings as a mediator between environmental characteristics and place attachment (Stedman, 2003). The physical characteristics of a landscape provide the frame or limits for the interpretation of the place (Ingalls et al., 2016; Masterson et al., 2017), for example, a river allows for the creation of meanings associated with fishing. In consequence, spatial or landscape planners are able to shape place meanings (Stedman, 2008). And vice-versa, the current sense of place influences how people interact with and shape the landscape, thus to their environmental stewardship behaviour (Devine-Wright and Howes, 2010; Gottwald and Stedman, 2020; Stedman, 2002).

Hence, the integration of sense of place into the planning processes holds many opportunities. It could enable needs-based planning. Knowing the citizens' sense of place, which means their specific place meanings and its location can give planners the opportunity to shape and design the landscape in order to create or preserve potential for certain meaning types (Stedman, 2008). Furthermore, it promotes consent oriented planning, by minimising potential land use conflicts (Ives et al., 2015). For example, place attachment is positively related to place protective behaviour (Devine-Wright and Howes, 2010; Gottwald and Stedman, 2020; Stedman, 2002). Finally, it would promote a more integrated planning approach, because emotional connectedness to place can motivate cooperation efforts (Manzo and Perkins, 2006), such as attending discussions on local landscape development (Höppner et al., 2008), and enhances environmental stewardship (Ives et al., 2015).

Yet, the integration of sense of place into planning practice is lacking and underexplored (Manzo and Perkins, 2006; Ryan, 2011). Three main shortcomings could be identified inhibiting the use of sense of place in planning practices. First, there is a myriad of related, but incoherent concepts and terms related to sense of place, such as place attachment, place meanings, place identity or place dependence (Hernández et al., 2014; Williams, 2014), which are used inconsistently throughout different disciplines and without a coherent understanding of the relation of those terms to each other. Second, there is a shortcoming of spatially explicit assessment methods, which would fit well in planning processes that use spatial indicators in their landscape assessments (Carvalho Ribeiro et al., 2019; Hermes et al., 2018). Place meanings are usually

assessed qualitatively, for example via interviews, photo-elicitation methods (Stedman et al., 2004), or free listing exercises (Wartmann and Purves, 2018). Place attachment assessments usually use a quantitative approach with established Likert-scales (Lewicka, 2011). There are few examples that have spatially assessed sense of place including the sub concepts of place attachment and place meanings. Existing spatial assessments on sense of place tend to rely on predefined spatial delimitations, such as administrative boundaries of neighbourhoods or national parks. Yet, these administrative units may only poorly represent the actual environmental exposure of an individual (Perchoux et al., 2013). First attempts to integrate the individual spatial interpretation in sense of place studies have been made by Brown et al. (2015), who used a participatory mapping approach and observed critically that their spatial assessment of place attachment did not cover the different dimensions and intensity of the concept. The third main shortcoming can be seen as a consequence of the above mentioned. There is a lack of clear and actionable guidance for landscape planners and managers to assess and integrate sense of place in planning practice.

Therefore, this dissertation aims to explore a systematic integration of sense of place into spatial and landscape planning, which is guided by the following objectives:

- (1) Develop and evaluate a spatial indicator for the assessment of sense of place to enhance the systematic integration of sense of place into spatial planning (*Article I and II*)
- (2) Apply the indicator to assess sense of place of citizens in a case study area (*Article II*)
- (3) Explore the relationship between sense of place and environmental stewardship as an alternative to traditional planning practice (*Article III*)
- (4) Integrate sense of place into a planning workshop and derive suggestion for integrating sense of place into landscape planning practice (*Article IV*)

To fulfil the objectives, I present a meaningful place indicator to spatially assess sense of place which is applied in a Public Participation GIS (PPGIS) survey carried out in a river landscape. In a next step, the results (meaningful places) are integrated into a Geodesign workshop with stakeholders responsible

for administrating the river and its landscape on different spatial scales. PPGIS methods allow assessing spatial data of statistically representative samples and to analyse the spatial distribution using for example hotspots (Raymond et al., 2014). There are abundant examples of the use of PPGIS for the assessment of social values, such as place attachment (Brown et al., 2015), perceived cultural ecosystem services (Plieninger et al., 2013), landscape values (Garcia-Martin et al., 2017), or perceived environmental quality (Kyttä et al., 2015). These spatial information can be used in planning, as maps represent a common planning tool (Kahila et al., 2015). One way to facilitate the integration are Geodesign workshops. Geodesign is a planning-support process and can be defined as ‘a design and planning method which tightly couples the creation of design proposals with impact simulations informed by geographic contexts, systems thinking and digital technology’ (Steinitz, 2012, p. 12). It is a deliberative approaches of social value assessment, which is based on communication, but allows only a small part of the society or stakeholder group to participate in discussions or workshop settings (Raymond et al., 2014). Combining PPGIS methods (instrumental approach) with Geodesign (deliberative approach) holds great potential, because both approaches are based on georeferenced maps and assume the prevalent importance of place-based values.

1.2 Structure of the thesis

This dissertation is organized around the four research objectives. Figure 1 illustrates how these objectives are connected to methodological approaches and articles.

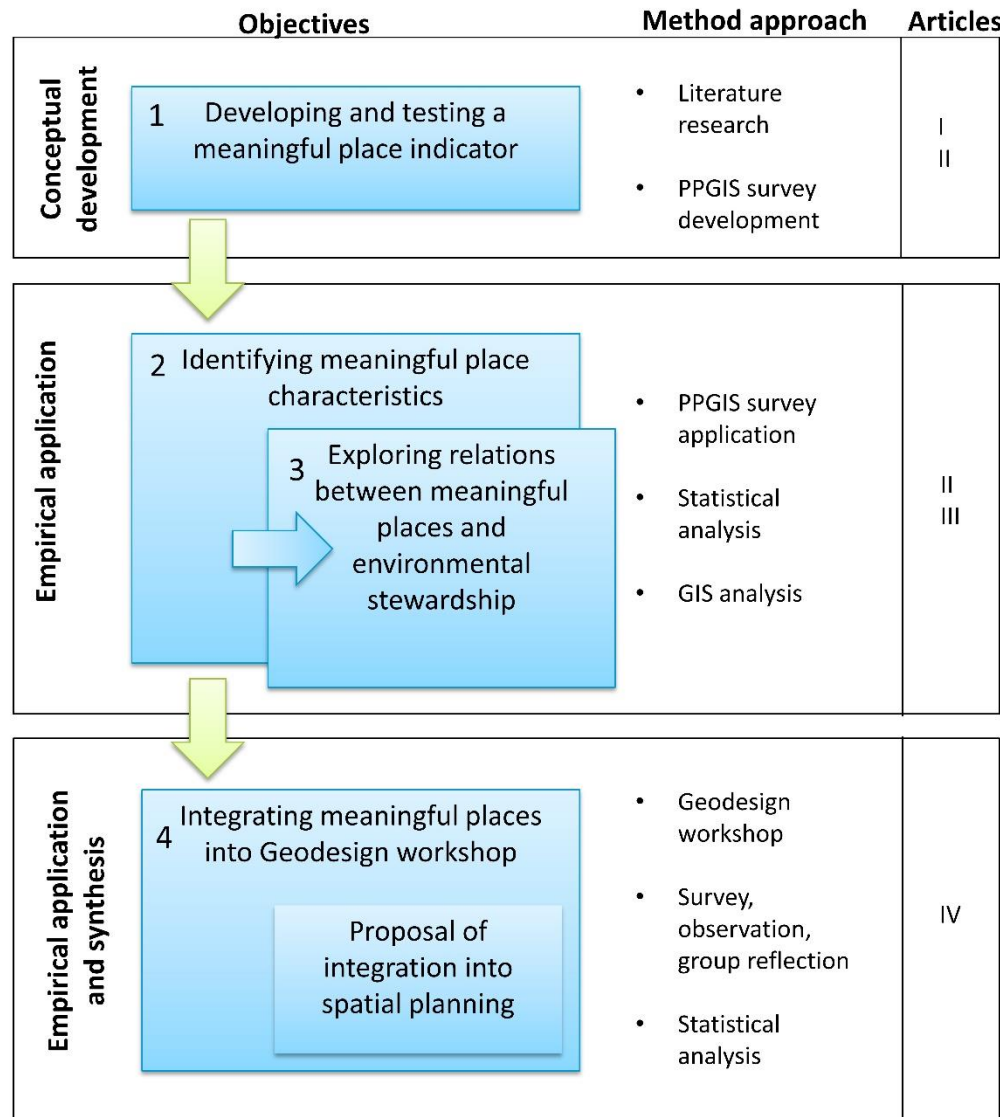


Figure 1 Research structure

Following the **first objective**, I reviewed existing literature and used Public Participation GIS (PPGIS) method to develop and evaluate a spatial indicator for sense of place for a spatial planning purpose. This was based on the literature on sense of place and related conceptualizations such as place attachment and extended to other concepts emphasizing people-place relationships, such as ecosystem services. In chapter two, I present the theoretical and conceptual background of this dissertation introducing 1) planning and managing river landscapes with a special focus on participation, and 2) sense of place as a valuable contribution to planning. Results are presented in the synthesis and discussion chapter (4.1), which is based on *Articles I and II*. To address the **second and third objectives** the spatial indicator for sense of place was applied and tested in a case study. Using different statistical and GIS analyses, meaningful places at the Lahn river landscape were characterized (chapter 4.2, *Article II*), and this characterisation related to local environmental stewardship

behaviour (chapter 4.2, *Article III*). The methods are described more precisely in chapter three, which provides an overview of the study area and the methods applied. I present the research design and how the different articles are connected to the approaches and methods applied. Furthermore, the two main participation tools applied in this dissertation are presented: Public participation GIS (PPGIS) survey and the Geodesign workshop. The chapter provides a brief overview of the different assessment and analysis methods used in combinations with these tools and discusses their limitations. For the **fourth objective**, a Geodesign workshop was designed integrating results from the meaningful place assessment. The proposal to integrate sense of place into spatial planning draws on results of objectives two and three (chapter 4.3, *Article IV*). Results from all objectives lead to a final conclusion chapter (5), where I present reflections on lessons learnt and future research directions as well as action advice for integrative planning and managing of river landscapes.

2. Background and concepts

This chapter introduces the most important theories and concepts applied within this dissertation. First, planning and management of river landscapes is introduced with a focus on the dynamics, societal challenges and available planning instruments. This leads to a presentation and reflection of the role of citizens within these planning and management processes, both in formal participation processes and informal approaches, such as environmental stewardship actions. In the second part, the theory of sense of place is introduced and how it is understood within this dissertation. There is a specific focus on the spatial assessment of sense of place and the opportunities of integrating sense of place into planning and management.

2.1 River landscape planning and the role of citizens

2.1.1 River landscape planning and management

River landscapes are complex social-ecological system, driven by ecological and human processes (Dunham et al., 2018), and characterized by hydrological cycles and biological systems, where different interests and values around the use of land and water meet (Antunes et al., 2009). River landscapes are very unique and specific ecosystem, characterized by the dynamic nature of a river changing due to natural or human processes, being at the same time connector (e.g. between upstream and down-stream communities, water and land) and separator which represents borders and is overcome via bridges or tunnels (Schönach, 2017). They are characterized by the interaction of cultural and hydrological dynamics (Wantzen et al., 2016) and finally the anthropogenic pressures on these ecosystems (Rockström et al., 2014a). Water plays a fundamental role in sustaining resilience of the socio-ecological systems, providing wetness of landscapes, ecological functions and services (Rockström et al., 2014b). River landscapes afford a multitude of ecosystem services, such as hydropower, drinking water, construction material, agricultural products, pisciculture products, carbon sequestration, flood retention, recreation, and aesthetic beauty (for an overview see Vermaat et al., 2015).

Yet, climate change and urbanization are threatening river landscapes, putting at risk both biodiversity and human livelihood (Vörösmarty et al., 2010; WBGU, 2011). Fresh water is needed to fulfil the ever-growing demand for food, which results from a growing population and economic development. Additionally, climate change will increase water scarcity as well as extreme weather event such as heavy precipitation, water pollutions threatens the ecosystems and industries are in ever greater need of water (Rockström et al., 2014a; von Haaren and Galler, 2011). In the European scenario, climate change and urbanization lead to an increase of people impacted by flood events (Rojas et al., 2013). Main drivers decreasing flood plains in Germany are an intensive land use, such as agricultural production, settlements or traffic, and technical river infrastructure, such as construction of dikes, waterway construction and impounded rivers. This leads to over half of all current floodplains to be highly or very highly modified (BMUB and BfN, 2009). Additionally, central Europe, including Germany, represents a hotspot of water bodies, which are not in a good ecological status or potential (EEA, 2018).

There has been a development of water resource thinking from a blue water centred approach, concerned with economic and engineering issues of water supply, focusing on technical infrastructure, towards an integrative approach, considering both land and water and including green water (evapotranspiration) as well as a stronger focus on nature-based, green infrastructure solutions (Albert et al., 2019; Fliervoet et al., 2013; Rockström et al., 2014a). Today, there is a multitude of integrated river landscape management approaches, which differ in the terminology, such as Integrated River Basin Management or Integrated Water Resources Management, but have in common the requirement of an integrated approach, including land, water, and stakeholder integration (Campbell, 2016). The latter responds to the need of integrating values of local citizens in the planning and management of river landscapes (Fliervoet et al., 2013; Westerink et al., 2017).

In line with these developments and in response to the complex societal challenges, nature-based solutions (NBS) have been recently proposed (Faivre et al., 2017). NBS address societal challenges, utilise ecosystem processes, and become embedded within viable governance or business models (Albert et al., 2019, *Article XI*). NBS integrates established ecosystem-based approaches such as ‘ecosystem services’, ‘green-blue infrastructure’, ‘ecological engineering’, ‘ecosystem-based management’, and ‘natural capital’ (Editorial, 2017; Nesshöver et al., 2016). In the case of river landscapes, it has been evident that NBS such as the protection of upstream forests supports downstream flood

protection, leading to a reduction in flood damage costs (Barth and Döll, 2016). The systematic integration of diverse stakeholder perspectives is a key requirement for successfully planning and implementing NBS (European Commission, 2015). Yet, its implementation continues to be under-explored in the literature (Raymond et al., 2017a).

This is evident in planning challenges imposed by water management needs, for example, in Germany. The sectoral administrative structure in Germany makes an integrated water management difficult. Legally, water management planning is part of water management and spatial planning, which are managed by different institutions and need to collaborate to use synergies and avoid conflicts. This is clearly contradicting EU policies such as the water framework directive or new concepts such as planning with NBS, which require a much more integrated management (von Haaren and Galler, 2011). However, in the case of Europe or Germany, there is a multitude of water management and planning instruments, such as water management plans based on the water framework directive, regulations on water protection areas, landscape planning, FFH impact assessment, common agricultural policy, or land use plans (Overbeck, 2011). In response Albert et al. (2020, *Article XII*) developed a planning framework, that includes among others principles of integration, equity and transdisciplinarity.

2.1.2 Participation in river landscape management and planning

Collaborative and participatory planning addresses the need of complex social-ecological systems to integrate the human and the biophysical domain, recognize its interdependency (Walker and Salt, 2006), and providing knowledge for a comprehensive understanding of systems and processes (Reed, 2008). Previous studies indicate significance of stakeholder participation for different fields of spatial planning, e.g., for landscape ecology (Luz, 2000), environmental management (Reed, 2008), environmental impact assessment (Sinclair and Diduck, 2017), or sustainable flood risk management (Challies et al., 2016). Participatory environmental planning arguably enhances trust building, reduces conflicts, increases support for planning proposals and facilitates social learning (Beierle, 2002; de Vente et al., 2016; Reed, 2008). In a context of river rehabilitation, the perception of naturalness, risk and safety, and care and cleanliness, strongly influences how the outcome is received (Garcia et al., 2020a). Early participation has shown to ensure social acceptance (Müller et al., 2017). In contrast, lacking or late participation practices have proven to neglect local knowledge and lead to conflict (Böhm, 2011). Therefore

it is legally integrated in planning instruments, initiated on a European level through the Aarhus convention (UNECE, 1998). Yet, despite the required integration of stakeholder perspectives through participatory methods, social values are rarely considered in environmental management, compared to biophysical and economic values (Bryan et al., 2010). In Germany landscape planning documents, for instance, have a much higher share of information on biophysical values, such as soil types, water quality or biodiversity, than social values. The latter is usually limited to recreation or aesthetic quality, which is just one of five topics considered in landscape planning, such as soil, water, and species and biotopes (Von Haaren et al., 2008). These social values are usually based on biophysical indicators to be user dependent, repeatable and resource saving, yet methods differ throughout studies (Carvalho Ribeiro et al., 2019; Hermes et al., 2018).

Planning and management of river landscapes has seen some progress towards more diverse, intensive and formalized forms of stakeholder engagement (OECD, 2015). A paradigm shift can be observed from “command and control” towards an integrated approach. For European river management and planning, the introduction of the water framework directive (WFD) had spurred participatory practices in river landscape planning, yet depends on the governance cultures in different member states (Jager et al., 2016). The WFD requires in article 14 the inclusion of stakeholders via information, consultation and active involvement (European Commission, 2000; Jager et al., 2016). Further, formal and informal participatory practices are used increasingly to include local stakeholders, not only in landscape planning, but also in water management practices (von Haaren and Galler, 2011). Some more traditional formats include referenda, public hearings, public opinion surveys, negotiated rule making, consensus conferences, citizens’ juries or panels, citizens advisory committees and focus groups (Rowe and Frewer, 2000). Yet, these are laborious, include relatively small number of participants, and have shown ineffective to gather usable information for planning purpose (Kahila et al., 2015). Instead, interactive and digital tools are becoming increasingly prominent in participation practice to increase public involvement, which is enabled through internet communication technology and geo-information systems (Hansen and Mäenpää, 2008). Despite social value being to some degree integrated in river management and planning, most practices are still traditional and ineffective to highlight how people feel attached and connected to a place.

Apart from top-down initiated participations, stakeholders are able to overcome the systematic lack of integrating their values into planning by shaping the environment themselves. Environmental stewardship is an innovative governance approach which focuses on the stakeholders as main actors instead of the government (Opdam, 2017). Here, we define environmental stewardship as “all action taken, direct (e.g. collecting garbage) or indirect (e.g. signing a petition), have to impact a specific geographic location” (Gottwald and Stedman, 2020, p. 10). This draws on the understanding of Bennett et al. (2018) highlighting that environmental stewards protect, care for or responsibly use the environment, and of Larson et al. (2015) pointing out that these actions need to be manifested in a place and enhance the local environment. Local environmental stewardship efforts seek for a place-based impact, either directly, for example through responsible use or active conservation work, or indirectly, for example through signing petitions or donating money. The aims of these efforts can be divers, such as restoration, protection or conservation (Enqvist et al., 2019). Different variables are able to better explain the occurrence and motivation of environmental stewardship, which are 1) place characteristics, 2) personal characteristics, and 3) place relations and values. The physical place characteristics provide the frame or limits for the interpretation of and hence actions at the place (Ingalls et al., 2016; Masterson et al., 2017). Personal characteristics, such as capacity to act, self-efficacy, feeling of empowerment, personal values, beliefs and personal norms have shown to be related and spur environmental stewardship (Bandura, 2010; Chapin and Knapp, 2015; Dresner et al., 2015; Stern, 2000). Finally, environmental stewardship is very closely connected to sense of place (Fig.2). Sense of place helps to understand if, where and why stewardship occurs (Chapin and Knapp, 2015; Enqvist et al., 2019; Gottwald and Stedman, 2020), while in turn environmental stewardship contributes to the development of a sense of place (Gooch, 2003). This information can be of use for landscape planners and managers. Yet, despite the importance of understanding local environmental stewardship for landscape planning and the importance of place variables, little spatially explicit research has been done. Instead, most studies target either specific projects (Enqvist et al., 2019; Krasny et al., 2014) or groups of people (Larson et al., 2015; Scannell and Gifford, 2010).

2.2 The theory of sense of place and its integration into spatial planning

Beyond environmental stewardship, there is a need to understand the subjective relation between people and place for (river) landscape planning and management (Hausmann et al., 2016; Masterson et al., 2017; Stedman, 2016; Verbrugge et al., 2019, *Article VII*), because people are agents of change and subjectively interpret and perceive the landscape (Davidson, 2010; Stedman, 2016). Therefore, this chapter introduces the theory of sense of place, and how it is understood in the context of this dissertation. Furthermore, the state of art benefits and challenges of integrating sense of place into spatial planning are presented.

2.2.1 Grasping the theory of sense of place

While there is a general agreement on the roots of place research in phenomenological geography based on the seminal works by Tuan (1977) and Relph (1978), place research has developed differently in various disciplines, including sociology, psychology and natural resource social science (Trentelman, 2009). This led to a myriad of concepts and conceptualizations of place in place related research, such as sense of place, place attachment, place identity, place meaning, sense of community, place dependence (Hernández et al., 2014; Trentelman, 2009). Following, I will briefly mention some of these concepts and focus on sense of place as an overarching theoretical understanding of people- place relationship.

In the realm of this dissertation, biophysical characteristics of place are understood as essential for the formation of sense of place (Masterson et al., 2017; see also Stedman, 2003), taking the perspective of natural resource social science (Trentelman, 2009). In this view, ‘sense of place is elusive, subjective, and personal [... It] results from myriad interacting factors – situational, historical, cultural, political, environmental, personal, and social, among others’ (Ardoin, 2006, p. 112,113). The multiple meanings, sources and expressions of sense of place are not necessarily consciously considered by the respective person although they represent an important part of human existence (Ardoin, 2006; Lewicka, 2011). They are formed by interaction between the individual, social community, cultural symbols, bio-physical territory, political and economic systems (Ardoin, 2006; Raymond et al., 2017b).

Sense of place encompasses two sub-concepts: place attachment and place meanings (Fig. 2). ‘Place attachment are emotional bonds that form between

people and their surroundings' (Manzo and Devine-Wright, 2014, p. 1). It is an evaluative approach integrating different intensities and dimensions of attachment, such as place identity and place dependence (Raymond et al., 2010; Stedman, 2006; Williams and Vaske, 2003). The latter, focuses stronger on the functional attachment, measured for example with items such as "X is the best place for what I like to do". Place identity is an emotional dimension of attachment, measured for example with items such as "I feel X is a part of me". They carry some descriptive characteristics, yet their intensity is usually quantitatively evaluated on a 5-Points Likert scale (Lewicka, 2011; Williams and Vaske, 2003).

In contrast and in complementation, place meanings offer a cognitive dimension, describing reasons for a particular emotional connection to a place (Stedman, 2002). These can be simple adjectives (e.g. aesthetic beauty), symbolic interpretations (e.g. spiritual values), or describing the place character (e.g. variety of plants and animals) (Masterson et al., 2017). Place meanings are usually assessed using qualitative methods (Lewicka, 2011), such as interviews (Knaps and Herrmann, 2018; Manzo, 2005) or photo-elicitation (Tonge et al., 2013). Yet, there are some exceptions of quantitative studies, based on quantitative assessment, such as Stedman (2003) using a Likert scale to evaluate statement such as "My lake is a place to escape from civilisation", or Gottwald and Stedman (2020) using cultural ecosystem services in a multiple choice question. So far, place meanings have not been the focus of place research, in contrast to place attachment (Lewicka, 2011; Stedman, 2008). This is surprising as there is no meaning without attachment and no attachment without a meaning. The same place can provide different meanings and equally strong attachments for different individuals or equally the same meaning, but differently strong attachments (Stedman, 2003).

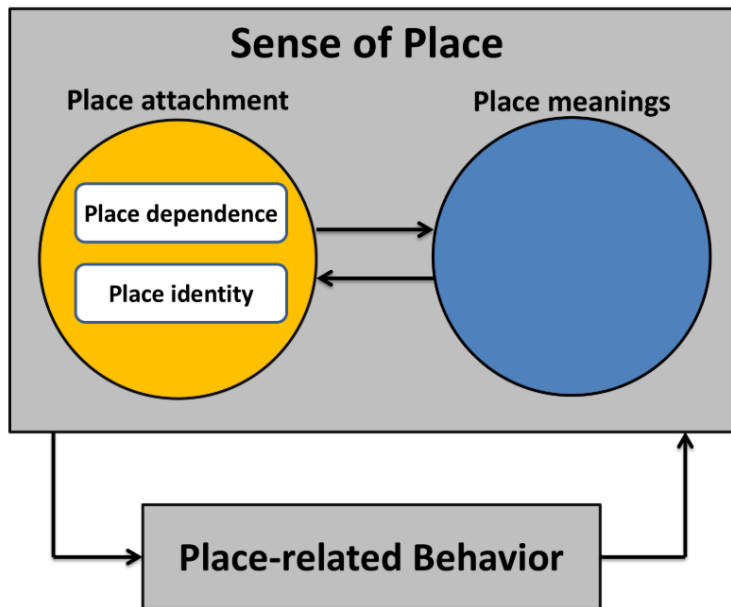


Figure 2 Illustration of sense of place, its sub concepts, and its relation to place-related behaviour or environmental stewardship (Masterson et al., 2017)

2.2.2 Spatially assessing sense of place

As shown above, sense of place encompasses different concepts, which are assessed differently and usually lack a holistic and spatially explicit perspective. Lin and Lockwood (2013) distinguish between nine different types to assess sense of place, which include 1) proxy measures such as length of residents, 2) phases or degrees of feelings, 3) place attachment (using 5point Likert scales), 4) symbolic meanings using more complex scales, 5) quantitative ranking method for environmental values, 6) qualitative methods, 7) spatial identification of place-based meanings, 8) photo-elicitation (with follow-up interviews), and 9) multiple methods, e.g. combining survey and interviews. Most of these studies rely on predefined spatial delimitations, such as administrative boundaries of national parks or neighbourhoods. Yet, these units may overlook the actual exposure of an individual to its environment (Perchoux et al., 2013). Additionally, from a planning and management perspective the spatially explicit holistic assessment of sense of place would be valuable, because planners' use of spatial information is a well-used planning tool, and planners and manager would be able to dedicate specific actions to shape and enable place meanings rather than to increase or decrease attachment (Stedman, 2008).

Therefore, it is worth to take a look at related concepts of people-place relationships that have richer experience in spatial assessments. The concepts of ecosystem services (MEA, 2005), nature's contribution to people (Díaz et al.,

2018), or landscape values, which “describe the socio-cultural perception of landscape functions” (Garcia-Martin et al., 2017, p. 2134), have been assessed participatory and spatially in a vast amount of studies (for an overview see Brown and Fagerholm, 2015). Specifically, cultural ecosystem services (CES), such as social relations, nature experience and education or cultural heritage, provide insights on the immaterial benefits of ecosystems to people (Plieninger et al., 2013). CES are defined as “ecosystems' contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human–ecosystem relationships” (Chan et al., 2012, p. 9). More recently, ecosystem services are increasingly valued through a relational value approach (see for example the recent special issue in Environmental sustainability (Chan et al., 2018)) which fits well to the theory of sense of place. Relational value can be defined as ‘the importance attributed to meaningful relations and responsibilities between humans and between humans and nature’ (Arias-Arévalo et al., 2017, p. 2). This aligns with an understanding of sense of place, where place itself can be dominated by natural features and where the meaning of the place, or the process of the attachment to that place, can be formed by social or cultural processes (such as social gatherings or traditional festivities), which reflect individual and social experiences (Masterson et al., 2017). Further, both CES and sense of place are used to understand place-based behaviour such as environmental stewardship (Chapin and Knapp, 2015; Mould et al., 2020; Schulz and Martin-Ortega, 2018). Yet, there are very few example that have connected these two approaches, an exception being Cundill et al. (2017), who have used the concept of place attachment to assess relational values of protected areas.

Sense of place belongs to the ecosystem services category of CES (MEA, 2005), but is one of the most neglected services (Hausmann et al., 2016). It has been part of the some ecosystem services assessment studies, defined as ‘sites that foster a sense of authentic human attachment, in German language commonly epitomized as *Heimat* (“home”)’ (Plieninger et al., 2013, para. 120), or combined with other concepts and operationalized as ‘I am inspired by feelings, new thoughts, religious or spiritual meanings etc.’ (Garcia-Martin et al., 2017). These examples demonstrate that the complexity of the sense of place theory was not grasped in the realm of ecosystem services research as it neglected the multi-dimensionality (emotional and cognitive, evaluative and descriptive dimensions). Additionally, sense of place may not be understood as a provider of well-being such suggested in the MEA (2005) framework, but rather as a part of the well-being construct, which has been shown in a study on multi-

functional landscapes (Fagerholm et al., 2020). In consequence, within this dissertation, sense of place is understood as the overarching theory and theoretical backbone and CES are understood as potential place meanings.

2.2.3 Opportunities and challenges for integrating sense of place in spatial planning

Landscape planning provides information on environmental objectives for example to develop plans required by the water framework directive (von Haaren et al., 2014). The integration of sense of place into spatial planning holds many opportunities, especially when the information is georeferenced, as in the case for most other indicators integrated in planning documents (Carvalho Ribeiro et al., 2019). Integrating sense of place into management and planning supports:

- (1) Needs based planning: Planners and managers have the opportunity to shape and design the landscape in order to create or preserve potential for certain meaning types (Stedman, 2008). For example, meanings related to social relations or nature experiences have different requirements on landscape design. Knowledge on place attachment and place meanings adds to planning indicators which have a strong focus on biophysical dimension and objectivity (Carvalho Ribeiro et al., 2019; Hermes et al., 2018). It provides subjective environmental values, which are often neglected in social-ecological systems research (Stedman, 2016) and planning. This knowledge helps to target planning efforts, highlighting sense of place hotspots and cold spots.
- (2) Consent oriented planning: Sense of place provides information which are related to people's identity and emotions, therefore affecting their behaviour and attitudes. It is related to citizens' intentions to embrace or reject landscape planning decisions (Tapsuwan et al., 2011). Place attachment and meanings relate positively to local environmental stewardship (Devine-Wright and Howes, 2010; Krasny et al., 2014; Scannell and Gifford, 2010; Stedman, 2002). There is evidence that environmental stewardship and thus place-protective behaviour is spurred by shared place meanings (Chapin and Knapp, 2015), intense place attachment (Devine-Wright and Howes, 2010) and number of meanings associated to a place (Gottwald and Stedman, 2020).
- (3) Integrated planning: The close link between sense of place and environmental stewardship allows planners to integrate and collaborate

with environmental stewards, because emotional connectedness to place can motivate cooperation efforts (Manzo and Perkins, 2006). This is in line with integrated river management objectives (Campbell, 2016).

Despite these advantages, sense of place is not commonly integrated into spatial planning. Reasons are related to: First, planning and research of social-ecological systems focuses rather on objective information and indicators than on subjectivity and perception (Carvalho Ribeiro et al., 2019; Stedman, 2016; Von Haaren et al., 2008). Second, there is a myriad of conceptualisation of people place relationships (Trentelman, 2009), which led to multiple assessment approaches (Hernández et al., 2014; Lin and Lockwood, 2013). Moreover, none of the methods combines a holistic assessment of sense of place, i.e., integrating place attachments and meanings, with a spatially explicit method, despite the fact that this kind of spatial information is used and needed in planning practice. This leads to the final challenge that there is a lack of guidelines on how to integrate sense of place into spatial planning, which is tightly connected to the lack of an indicator or method which turns the subjective character of sense of place into a tangible and measurable component for social-ecological research (Masterson et al., 2017; Stedman, 2016) and planning practice.

2.3 Knowledge gaps

Based on the state of research and challenges presented in the previous section, the main knowledge gaps are:

- (1) An understanding of people's emotional connectedness to river landscape is lacking. This is of special interest as this connection provides information on and allows conclusions of citizens' environmental stewardship behaviour. Particularly in light of new planning approaches such as planning with NBS, knowledge on people-place connection and environmental stewardship would enhance successful river landscape management.
- (2) The spatial assessment of sense of place is in its infancy. There is a need for a spatial assessment approach, which is valid, measurable, transferable and relevant.
- (3) Sense of place research has focused much more on place attachments and the people dimension than on place meanings and the place dimension. Yet, place meanings have shown to act as a mediator

between the perception of the biophysical characteristics and place attachment. This direct connection enables landscape planners and managers to actively shape potential place meanings.

- (4) Last, spatial assessment methods are needed which make the implicit explicit, the invisible visible through translation of values, knowledge and people-place connections, such as sense of place, into spatially explicit information that can be used and communicated for planning purposes. This lack of a spatial indicator for sense of place is a main obstacle to integrate sense of place in spatial planning that uses geographic information as its foundation of information.

3. Methodology and case

3.1 Research design and rationale

Planning support systems are a subset of geo-information technology-based instruments incorporating different components, such as data sets, algorithms, knowledge, that communicate information and support solution generation in planning activities (Geertman and Stillwell, 2004, 2003). Inspired by Raymond et al. (2014) and their work on valuation approaches for assessing cultural ecosystem services, we chose to use two opposing approaches to support planning of nature based solutions in river landscapes within this specific case study. Accordingly, we developed and tested methods to include sense of place into spatial planning using instrumental and deliberative approaches (Fig. 3).

More specifically, the instrumental approach used a **Public Participation GIS (PPGIS)** method. Using PPGIS surveys, participants map their perceived and experienced environment. It has been developed to enhance citizens' participation in landscape planning, management and decision making processes (Kingston, 2007; Sieber, 2006). It allows to reach a wide audience (Kahila-Tani et al., 2019), including previously underrepresented groups of citizens (Dunn, 2007), who benefit from an anonymous and non-conflicting setting (Carver, 2001; Kingston et al., 2000), as well as independence of spatial or time restrictions. For planning and management practitioners PPGIS methods deliver place-based information and statistical evidences for planning informed by local knowledge (Kahila-Tani, 2015; Kahila-Tani et al., 2019). GIS data, which is not based on 'hard facts', is termed 'SoftGIS' (Kahila and Kyttä, 2009). SoftGIS acknowledges the fact that people's perception of the environment and their interaction with it leads to the attribution of meanings of specific places (Brown and Kyttä, 2014). PPGIS methods have been used for the assessment of perceived environmental qualities (Kyttä et al., 2015), ecosystem services (for an overview see Brown and Fagerholm, 2015), or landscape values (Brown and Brabyn, 2012) in both urban and rural contexts.

To integrate sense of place in a deliberative map-based process, a **Geodesign workshop** was used. Geodesign approaches are able to address complex

planning tasks, such as planning of nature-based solutions in river landscapes. 'Geodesign is a design and planning method which tightly couples the creation of design proposals with impact simulations informed by geographic contexts, systems thinking and digital technology' (Flaxman, 2010; Steinitz, 2012, p. 12). Geodesign approaches are diverse and may range from employing digital mapping devices such as touch tables (e.g. Eikelboom and Janssen, 2015) or analogue paper maps supported by tracing paper or transparencies for drawing (Albert et al., 2015; Burrough et al., 2015). Specially, digital Geodesign approaches can include a wide range of features, such as sketching or impact evaluation (Ervin, 2011; Gottwald et al., 2020a; Janssen et al., 2015; Raumer and Stokman, 2013). Using Geodesign supports communication amongst stakeholder, but also of unfamiliar concepts or jargon, as it allows to translate opinions or ideas into spatial information (Gottwald et al., 2020a, *Article VI*).

These two different approaches have been selected because they show the breadth of possibilities to assess and integrate sense of place in a spatially explicit way. They are characterized by key similarities which enables a combination of both, and are still different enough to be complementary. Both approaches presented in this thesis are based on geographic maps in order to allow for the assessment and integration of sense of place in spatial planning. Geodesign workshops as well as online PPGIS methods can be seen as subsets of planning support systems. Both can be used to support the river landscape planning, because they are based on georeferenced information, use geoinformation system technology, and the integration of stakeholder knowledge and values. Citizens themselves actively locate values, relationships to the place, or design options, which is crucial for sustainable planning (Carver, 2001). Yet, Geodesign workshops and PPGIS methods differ substantially in some other aspects. Geodesign workshops enable active collaboration and consensus finding. They are exclusive in terms of capacity (limited number of participants), geographical location and time slots. In contrast, PPGIS, offers a more flexible and anonymous participation space (Kingston et al., 2000). PPGIS effectively collects spatial data from the local residents, but lacks behind in achieving discourse and collaboration (Brown and Kytä, 2014), which is a key element of Geodesign workshops.

3.2 Research context and study area

3.2.1 Study area: Lahn river landscape

The river Lahn stretches over 246 km, from the shallow Rothaar mountains in the federal state of North Rhine-Westphalia, continuous for 140 km through Hesse and flows in the river Rhine. The watershed extends over 6000 km². The landscape is characterised by an urban-periurban-rural mix with several medium- and small-sized settlements, connected through a highway next to the river. Rural areas are dominated by grassland, cropland and, with increasing distance to the river, forests (Fig.3). Flood regulation requirements and earlier demands for transportation of goods and hydropower generation led to the construction of around 70 sluices and weirs. Their rather costly maintenance is debated (Albert et al., 2019, *Article XI*). The former floodplain is lost to settlements, infrastructure and intensified agriculture, causing ecological deficits, according to Water Framework Directive assessments (HMUKLV, 2015; LiLa, n.d.). Recreation use, specially water sport activities create a significant pressure on the river (HMUKLV, 2015). Enhancing the ecological situation requires the integration of divers stakeholder interests, such as hydro-energy production, or recreational boating, fishing, biking and hiking (Albert et al., 2019, *Article XI*). The current situation requires rethinking the design of the river landscape as well as the planning of the design, by integrating multiple interests and values.

Apart from these challenges, which can be effectively addressed by nature-based solutions, the study area was chosen because it is part of a transdisciplinary project (see chapter 3.2.2), which offered the unique opportunity to support the project partners in their effort to design a concept of an ecologically enhanced river landscape. Moreover, ongoing planning activities and organized environmental stewardship initiatives highlight the need to go beyond an integration of objective information and finally account for the emotional connectedness that people have to the place, which encourages environmental stewardship, but at the same time has not been included in any planning and design efforts. There is already a basis of existing spatial and landscape planning documents, such as the management plan Hesse (2015-21), which also aims at a good ecological status and is a product of the water framework directive. It provides recommendations to reach this particular aim, for example suggesting the removal or redesign of weirs to considerably reduce the amount of backwater, or the improvement of fish ladders (HMUKLV, 2015). Further, several communes are funding the planning of the integrated

development concept of the Lahnpark, focusing on a smaller stretch of the river (13 km²) and focuses on nature-based recreation, as well as the sustainable protection and development of nature, landscape and flood protection (Lahnpark GmbH, 2010). In response to the latter planning activity and to mainly promote the maintenance of the status quo of the river landscape, some civil society groups in the study region are engaged. The most active groups are ProLahn association and “Schützt die Lahnaue e.V.” (protect the Lahn flood plain) initiative. The ProLahn e.V. initiative is an association of motor boat enthusiasts and organizes public events and participatory processes to promote the maintenance of a navigable river for motor boats. The citizen initiative “Schützt die Lahnaue e.V.” (protect the Lahn flood plain) published a citizen manifest and organizes demonstrations to oppose a plan for more tourism activities in the river flood plain promoted by Lahnpark GmbH (2010).

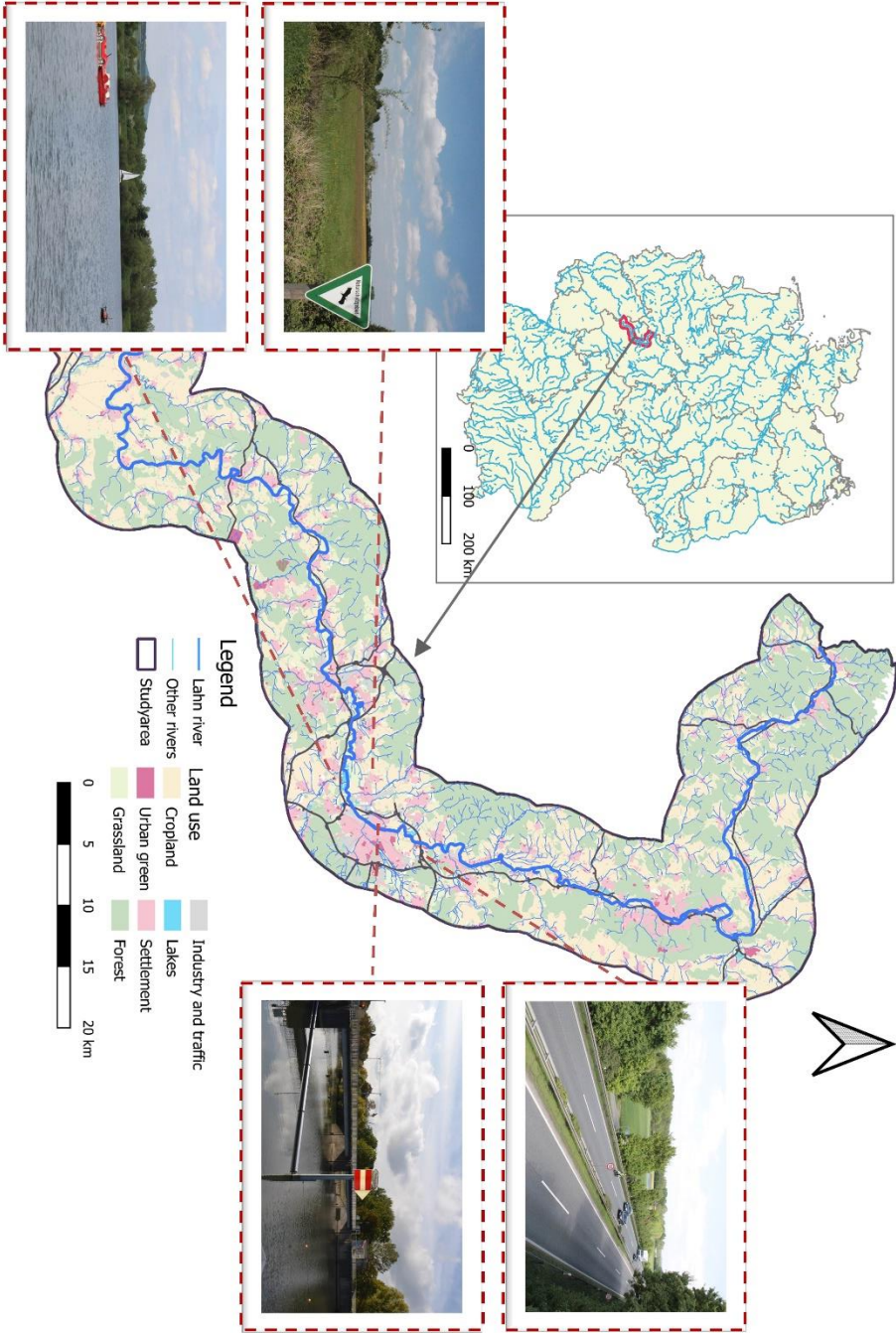


Figure 3 Study area with illustrative photographs (taken by author), *source: Gottwald et al, under review, Article II*

3.2.2 Transdisciplinary project

Responding to challenges of a sustainable development of the Lahn river landscape, the integrated EU life project Living Lahn (LiLa, lila-livinglahn.de) was founded in 2015, for the duration of ten years. It consists of administrative institutions acting on a wide range of local to federal levels: The Hessian Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection (HMUKLV), the Governmental Authority of Gießen (RPGI), the

Ministry of Environment, Agriculture, Nutrition, Viniculture and Forestry of Rhineland-Palatinate (MUEEF), the Directorate for Infrastructure and Approval North (SGD Nord), the Waterways and Shipping Office Koblenz (WSA Koblenz), the German Federal Institute of Hydrology (BfG), and the federal Waterways and Shipping Office as an extended member. The aim of the Lila consortium is to “enhance the ecological health and connectivity of the river itself, while simultaneously enriching the quality of life along the river” (LiLa, n.d.). One core action is the development of a “Lahn Concept”, which integrates aspects of recreation, ecology and flood protection and builds on a dialogue with local citizens. The Living Lahn consortium has been highlighted as a pilot project for the design of other confluent river development strategies (BMVI and BMUB, 2017).

This thesis is part of the PlanSmart research group (www.plansmart.info) (supported by a research grant from the German Ministry of Education and Research BMBF), which is a transdisciplinary project closely collaborating with the LiLa consortium (Albert et al., 2019, *Article XI*). Transdisciplinarity can be defined as “a reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems and concurrently of related scientific problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge” (Lang et al., 2012, p. 26,27). Transdisciplinary research is needed for addressing complex sustainability because 1) it enables knowledge input from different disciplines from sciences and practice, 2) it provides “guidance for transition and intervention strategies”, via goals, norms and visions, in addition to problem analysis, and 3) it increases “legitimacy, ownership, and accountability” for solution options. Yet it may also present many challenges, such as 1) lack of problem awareness, when a joint definition of the problem is missing, 2) imbalance of problem ownership when initiated by scientists, 3) lack of legitimacy caused by the selection of practice partners and underrepresentation of some stakeholder groups, 4) paucity of guidance for methodological quality standards, 5) need of continuous participations of the participants leading to a fragile condition, 6) risk of generic and ambiguous results overlooking potential conflicts, 7) limited solution options with focus solely on the specific case, and 7) monitoring and evaluation of societal impacts (Lang et al., 2012).

The transdisciplinary research between the PlanSmart research group and the LiLa consortium was realized carrying out so called “LahnLabs”. The LahnLabs were a series of workshops aiming at supporting the LiLa consortium in finding strategies for the river landscape, with a focus on planning with nature-based

solutions and gaining scientific knowledge on planning for nature-based solutions. One of the LahnLab workshops was also part of this thesis (chapter 3.4) and reflected the advantages and challenges of transdisciplinary research. The collaboration enabled the researcher to start a workshop where trust and a good work atmosphere had been already established in previous (two) workshops and meetings. Yet, challenges persisted which needed to be integrated into the conceptualization of the workshop, such as different spatial foci of partner institutions (ranging from local to federal), different competencies and responsibilities (e.g. decision-making and consultancy), educational backgrounds of the participants, and different interest in some areas such as river navigation and nature conservation (Henze et al., 2018). Nevertheless, the level of trust developed during previous events and a number of identified common interests, such as enhancing ecological quality and recreational opportunities (Henze et al., 2018), enabled a successful workshop.

3.3 PPGIS method to assess sense of place

3.3.1 Data assessment methods: PPGIS survey and sampling

Two sampling strategies have been used: a random and a self-selected sample. A random sample of 3000 citizens, aged 18 years or older, in thirteen communes, adjacent to the river received an invitation by mail consisting of a personal letter with an individual code and a guide sheet to complete the survey. After two weeks, those who did not respond received a reminder post card. The addresses of the participants were obtained from the German Postal Agency, a private company storing, analysing and selling addresses. Their addresses are based on the local registration offices. For the self-selected sample, information on and invitation to the survey appeared on local print and digital media, including social media platforms and a radio station, as well as official city websites.

The survey was design in and hosted by the online PPGIS platform Maptionnaire™. Respondents were provided with a video tutorial and an instruction page (accessible directly from the survey) explaining how to locate a point on the map that was. Participants were asked to spatially locate up to three meaningful places on the map and to provide further details on that place in a pop-up window that opened automatically after locating a point. These details included the specific meaning of that place, their attachment, visiting frequency and willingness to act (Link: <https://app.maptionnaire.com/en/800/>, Fig. 4).

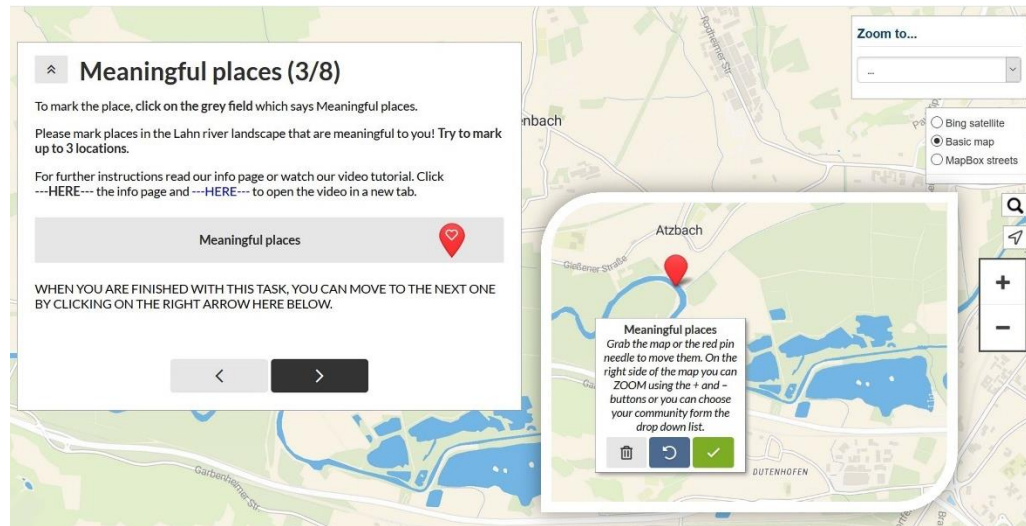


Figure 4 PPGIS survey interface, screenshot from <https://app.maptionnaire.com/en/800/>, accessed 12.11.2020

The survey was used to spatially assess the meaningful place indicator. Additionally, information on participants' socio-demographic background, such as age and gender, and psychological attributes, such as environmental citizenship were assessed. Table 1 gives an overview on all variables assessed through the PPGIS survey, spatially and non-spatially, and additional variables used in the analysis (see 3.3.2).

Table 1. Assessed variables and variables used in the analysis, *assessed through PPGIS survey, ¹ source: Digital Basic Land-scape Model (2016) provided by Federal Agency for Cartography and Geodesy, ² source: Corine land use data (EU)

Variable	Measured items	Reference	Article		
Meaningful place indicator	Place attachment *	(Raymond et al., 2010; Stedman, 2006; Williams and Vaske, 2003)	I, II, III		
	Place meaning *			(MEA, 2005; Plieninger et al., 2013; Rall et al., 2017)	II
	Free listing: „Why is this place meaningful to you?“				I, II
Visiting frequency *	Frequency in which the respondent visits the meaningful place - Ordinal scale from 1 to 6		II, III		

		Daily, Weekly, Monthly, Semi-Annually, Annually, Less than Once a Year		
	Environmental stewardship*	Would you support or take actions to preserve this place? – Binary (yes, no) and open question on types of action		III
Physical environment	Land use types ¹	Nominal: vegetation and forest, agriculture, grassland, settlement, industry and traffic, urban green, lakes and rivers		II, III, IV
	Protection status ¹	Protection status (proportion of protected area within 500m radius), Green space (proportion of green space within 500m radius) (Article II) Separately considering a low protection status (landscape protection areas) and high protection status (Flora Fauna Habitat areas) - Binary: 1 – meaningful place is inside protected area, 0 - Meaningful place is outside protected area (Article III)		II, III
	Hemero by ²	“ the distance between the current vegetation and a constructed final state of self-regulated vegetation in the complete absence of human intervention (so called potential natural vegetation (PNV))”(Walz and Stein, 2014, p. 279) Ordinal scale: 1 - almost no human impact, 2 – weak human impacts, 3 – moderate human impacts, 4 – moderate-strong human impacts, 5 – strong human impacts, 6 – very strong human impacts, 7 - excessively strong human impact	(Walz and Stein, 2014)	III
	Distance from home Distance from the river*	In meter		II
Personal attributes	Environmental citizenship*	Are you currently a member of any environmental, conservation, or wildlife protection group?; During the past year have you contributed money to an environmental, conservation, or wildlife protection group? “Yes” (5), “No” (1) How frequently do you watch television programs, movies, or internet videos about environmental issues?; How often do you talk to others about their environmental behaviour? “ Never ” (1), “ rarely ” (2), “ sometimes ” (3), “ often ” (4), “ constantly ” (5) I want to live as ecologically as possible; I am very concerned about environmental issues (5 point Likert scale) <i>The variable environmental citizenship thus represents the mean value of all 6 items and ranges between 1 and 5</i>	(Markle, 2013)	II, III
	Local knowledge*	How do you evaluate your personal knowledge on LOCAL topics such as: Social topics (e.g. need for social housing); Environmental topics (e.g. high biodiversity areas, pollution risks) Economic topics (e.g. employment situation); In General (No knowledge, Very little knowledge, Some knowledge, Sound knowledge (sufficient to act), Very sound knowledge (could give a detailed explanation), Not applicable)		II, III
	Local membership*	Membership in a local organisation, not necessarily tied to environmental issues, e.g. volunteer firefighters, active in the church, sports association, Binary: 0 – no, 1 – yes		III
Socio-demographic	Age Gender Education Income*	Male, Female, Other Social gender - Binary: 1 – male, 2 – female Comprehensive school, Secondary school, Upper secondary school, Vocational school, Bachelor’s degree, Master’s degree, Doctoral degree, Other Highest education degree - Ordinal scale: 1 - 8-10yrs of school, 2 – 12-13yrs of school, 3 – academic education (B, M, PhD) under 500, 500 to under 900, 900 to under 1300, 1300 to under 1500, 1500 to under 2000, 2000 to under 2600, 2600 to under 3200, 3200 to under 4500, 4500 or more Monthly net income, recoded based on average income - Binary: <2600€, =>2600€ Age: Year of birth, subtracted from year of the survey (2016) – continuous Current professional occupation – Binary: 0-not retired, 1-retired and Nominal (see survey)		II, III

3.3.2 Data analysis

Geographically, the study analysed a stretch of the river Lahn in the federal state of Hesse (140 km), including a 5 km wide buffer on each side of the river (Fig.3). The 5 km distance was used to include a maximum number of points. Dominating land uses within the study area (Fig.5) are forests (42% of the total area), croplands (27%), and grasslands (14%). For the statistical analysis we used IBM SPSS Statistics 26, for GIS visualisations and analyses we worked with Quantum GIS 3.4.10. Different types of statistical analyses have been carried out using the survey and additional data (Tab.1), including deductive coding, descriptive statistics, Spearman's rank correlation analysis, factor and reliability analysis, chi-square analysis and standardized residual values, one-way ANOVA, and step-wise linear regression analysis. Additionally, QGIS was used for visualizations and basic analyses such as calculating distances and buffer. Further details on the various statistical analyses can be found in the different manuscripts, which can be found in the appendix of this dissertation.

3.4 Geodesign workshop integrating sense of place

The meaningful places assessed using the PPGIS survey have been integrated into a Geodesign workshop (*Article IV*). The workshop design was based on the analysis of past Geodesign workshops (Gottwald et al., 2020b, Publication V). A stretch of about 31.6 km of the Lahn river and 2259 ha of the river landscape in Hesse, Germany, was selected as a case study for the Geodesign process (Fig.5). The extent of the study area needed to be adapted to the screen size and to the capacities of the workshop. Participants needed to be able to fulfil the workshop tasks in a given time, which was limited 30 minutes for the first tasks working with meaningful places and around two ours for the rest of the workshop tasks, which required to reduce the overall extent of the study area compared to the entire study area of the PPGIS analysis. The chosen extent includes most of the located points.

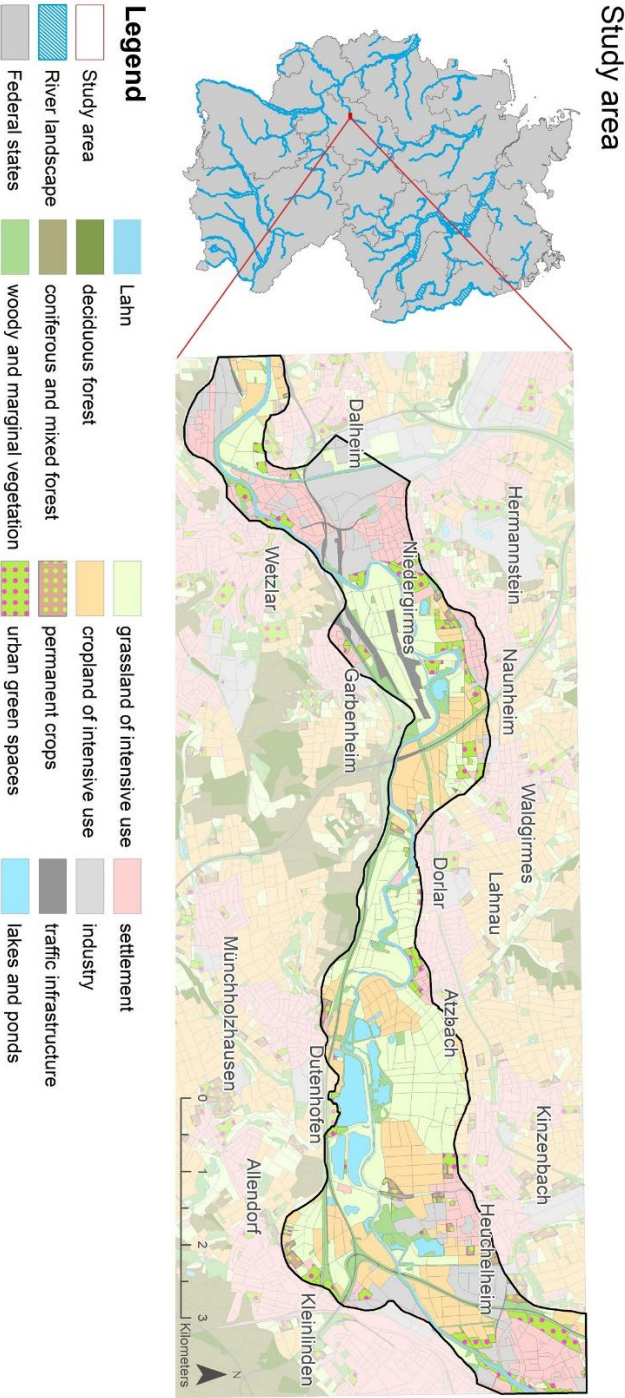


Figure 5 Study area Geodesign workshop, source: (Gottwald et al., 2020a, Article VI)

3.4.1 Set up of Geodesign workshop

The Geodesign workshop consisted of two main parts: first, working with meaningful places assessed by local citizens (*Article IV*), and second designing nature-based solutions in two different scenarios (Gottwald et al., 2020a, *Article VI*). This dissertation will focus on the first part of the workshop. A digital and interactive workshop design was chosen using two touch tables (Iyama 33 and 52) and a specifically prepared GIS interface (ArcGIS 10.6 with the CommunityViz extension). Participants received spatial data on land use,

protection status, settlements, weirs, sluices and dams, and recreational infrastructure, derived from a ATKIS Base Digital Landscape Model (BKG, 2016) provided by the Federal Agency for Cartography and Geodesy. Information on recreational infrastructure had been enhanced using Open Street Maps (camping areas, canoe clubs or ports). Additionally, to ease communication and to serve as the basis for more local-level impact assessments, the study area was divided into river segments of 1km each, based on earlier assessments of river landscapes (BMUB and BfN, 2009).

The digital map interface enabled participants interacting with spatial information, drawing meaningful areas, writing down the meanings, changing land uses and receiving feedback in terms of impacts on ecosystem services provision. In order to allow all participants to actively engage in the spatial co-design, participants were divided into two groups (Group A and Group B), both of which were provided with access to a touch table and identical Geodesign software. Participants were assigned to one of the two groups by the workshop organizers in such a way that both groups included the diversity of institutions and contained at least one person who was involved in developing both the Market and the State scenario in a previous workshop, respectively. During the workshop, participants were standing around the touch tables, discussing and fulfilling the tasks, such as writing and drawing (Fig. 6).



Figure 6 Impression from Geodesign workshop, participants could use a pen or their finger to draw and write on the map, source: *Gottwald et al, under review, Article IV*

3.4.2 Workshop data collection and evaluation

To better understand how meaningful places were received by participants, three different types of assessments were used: first, observations during the workshop, which had been written down in structured protocols and were enhanced by audio records. Second, tangible workshop results in form of drawings and writings by the participants; and third, feedback by the participants through a mini-survey, written feedback statements on moderation cards and a final discussion round.

3.5 Limitations

There are four major methodological limitations in this dissertation: the first is related to the sampling method of the PPGIS survey, the second refers to issues of the digital divide, the third to the integration of sense of place in the entire workshop, and the fourth to terminologies.

Sampling method: This study combined two different sampling methods. For the random sample, official postal data was used, employing a company to select a random sample. Yet, the respondents' socio-demographic characteristics do not represent the local population. It was impossible for the researcher to access the data and ensure a random selection, because of data privacy policies. In consequence, respondents in the random sample are much older and male dominated than the general public. This study also yielded a low response rate, which is not unusual for online PPGIS studies, but was below the average of previous studies (around 13%) (Brown and Kytä, 2014). This may be partly explained by the sampling methods employed, resulting in a high amount of older adults, who usually experience the use of digital devices and online maps as more challenging (Gottwald et al., 2016; Rzeszewski and Kotus, 2019). This directly links to the second limitation of this study.

Digital divide: PPGIS studies have shown to be able to address underrepresented parts of the populations as well as people who are not used to participate in planning processes (Dunn, 2007; Garcia et al., 2020b, *Article VIII*; Kahila-Tani et al., 2019). However, relying on new technologies may raise the digital divide, which means that certain groups of people encounter obstacles in using digital tools, such as PPGIS surveys, for example based on social class, status or age (Gottwald et al., 2016; Kahila-Tani et al., 2019; Lindblom and Räsänen, 2017). To ease the usability of the survey, analogue and digital guides as well as a tutorial video were provided. Yet, usability and consequences of the phenomenon of the digital divide were not assessed in the

realm of this PPGIS study. In relation to the digital divide, there has been one restriction in the set-up of this survey. Based on experience from previous PPGIS studies and a usability assessment (Gottwald et al., 2016), we decided to use point geometry only, which is the easiest to draw. This means, respondents were only able to draw points on the map, not lines or polygons. This should secure a lower dropout rate due to frustration. However, as responses to a survey question on the geometry of the meaningful place, as well as the types of meanings, indicate, the geometry or extent of the meaningful place was not always limited to a single point in the landscape, but in fact would include a longer route, such as a specific bike trail, or a larger area, such as the part of a forest or city center. This has not been considered in the data analysis until this point.

Sense of place in the Geodesign workshop: Sense of place was integrated in the first and smallest part of the Geodesign workshop. Yet, it was not the core objective of the overall workshop. The workshop was part of the Lahn Labs which aim at enhancing the understanding on planning with nature-based solutions. Participants had the opportunity to visualize meaningful places as well as their drawings based on these points throughout the entire workshop. In consequence their action in the following tasks may have been influenced by these first exercises with the sense of place data. However, the second part of the workshop dominated the overall event in content and extent. Participants also critically mentioned that the connection between the two parts was not clear enough.

Diverse and partly contradicting terminologies: For the key theory, i.e. sense of place, and key concept, i.e. environmental stewardship, of this dissertation, literature research has been difficult due to a myriad of incoherent terms and conceptualizations. Furthermore, discussion with the results suffered from incoherent use of the same terms. For example, for environmental stewardship, there are more general terms, such as environmental behavior (Stedman, 2002) or stewardship (Chapin and Knapp, 2015), and more specific expression, such as local environmental stewardship actions (Bennett et al., 2018). Other authors juxtapose terms, such as pro-environmental behavior (Scannell and Gifford, 2010), that in this dissertation partly describe environmental stewardship and partly capture environmental citizenship, which does not have a place specific action context. In this dissertation the term environmental stewardship is defined as “all action taken, direct (e.g. collecting garbage) or indirect (e.g. signing a petition), have to impact a specific geographic location” (Gottwald and Stedman, 2020, p. 10).

4. Synthesis of results and discussion

In this chapter, I will briefly revisit the main objectives of the dissertation, summarize the main empirical findings and discuss their contribution to the existing literature. A spatial indicator for the assessment of sense of place had been successfully developed and tested, namely the meaningful place indicator (*Article II*), and evaluated using benchmark criteria for environmental indicators (*Article I*, Objective 1). Furthermore, meaningful places of local citizens in the river Lahn landscape had been assessed and related to their personal attributes and to place characteristics, highlighting the importance of a holistic assessment, i.e. combining place meanings and attachments (*Article II*, Objective 2). This has also revealed synergies between the well-established concept used in spatial assessments, cultural ecosystem services, and the theory of sense of place (*Article II*). Additionally, the relationship between sense of place and environmental stewardship has been assessed, as well as between environmental stewardship and personal and biophysical attributes (*Article III*, Objective 3). Along, these analysis on the relationship between place meanings, attachments, environmental stewardship, personal attributes and biophysical attributes of the place had revealed the central role place meanings are playing in the people-place relationship. Finally, sense of place information had been integrated in form of the meaningful places into a deliberative Geodesign workshop. The positive feedback of the workshop participants on the use of sense of place had encouraged the proposal of an integration of sense of place into a landscape planning process, highlighting the potential benefits (*Article IV*, Objective 4). In the following, I will reiterate and discuss the main findings with special focus on spatial planning and governance of river landscapes. The respective articles in the appendix of this dissertation offer additional details on the specific findings.

4.1 A spatial indicator for the assessment of sense of place (Articles I and II)

A core result of this dissertation is the development of a spatial indicator of sense of place, called meaningful place indicator (*Article II*). The indicator integrates place attachment based on spatial and mostly non-spatial scales of place attachment representing the dependence and identity dimensions (Raymond et al., 2010; Stedman, 2006; Williams and Vaske, 2003), see conceptual framework (Fig. 8) and summary of variables (Tab. 1). The framework also represents the strong relation between place attachment and meanings. Meanings are operationalized using two approaches: first, a free listing approach assessing meanings qualitatively, as done in previous studies (Wartmann and Purves, 2018), and second a list of cultural ecosystem services. Multiple lists of cultural ecosystem services have been established for spatial assessment purposes, such as (Brown and Fagerholm, 2015; Plieninger et al., 2013). Yet, these lists are not expected to capture the entire breadth of potential place meanings. The conceptual framework (Fig.7) shows that the indicator is embedded within the social ecological system, assessing the relational values linked to ecosystems and their services. Both dimensions of the systems, namely ecosystems and socio-economic systems interact with each other, providing ecosystem services and driving changes (Maes et al., 2016). Additionally, they determine how people feel emotionally connected to place. Relational values, which can be understood through the lens of sense of place theory and captured using the meaningful place indicator, represent how people perceive ecosystems based on both, the biophysical characteristics of the place and the person characteristics. The physical environment provides the limits and preferences of possible constructed and attributed place meanings (Ingalls et al., 2016; Masterson et al., 2017). In addition, meaningful place perception is influenced by values (Brown et al., 2020) and personal attributes (Raymond et al., 2017b), such as socio-demographic characteristics, environmental attitudes and local knowledge. Hence, the indicator captures the relational values that connect people (right part of the framework) and the environment (left part of the framework).

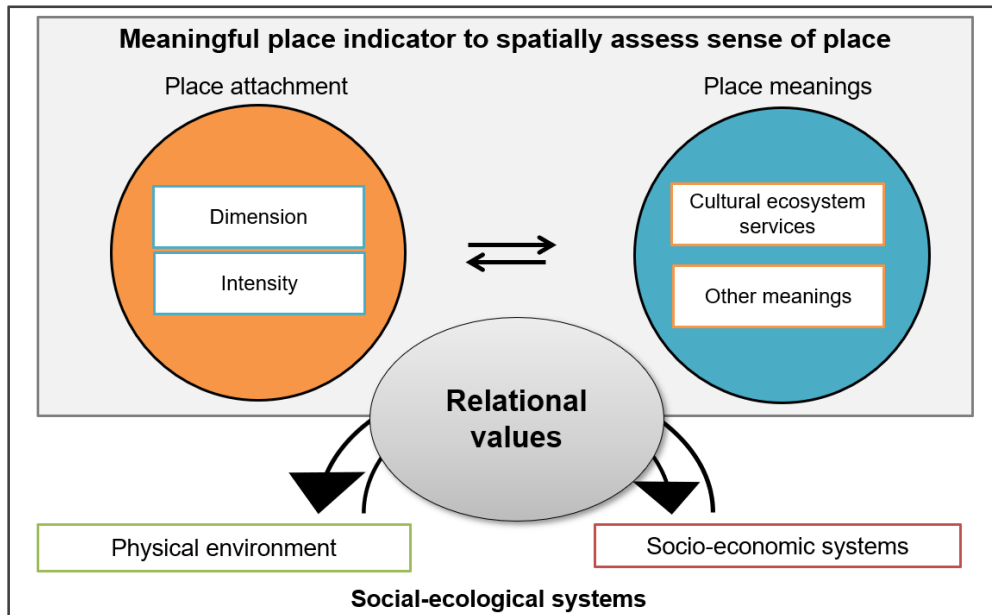


Figure 7 Conceptual framework, based on (Maes et al., 2016; Masterson et al., 2017), source: Gottwald et al., under review, Article II

The indicator is proposed to support the integration of sense of place into spatial planning where there is a paucity of coherent guidelines and a multitude of conceptualizations around people-place relationships challenges the practical uptake. The indicator has been evaluated using benchmarks of environmental indicators (*Article I*), namely validity, intended purpose (Niemeijer and de Groot, 2008; van Oudenhoven et al., 2018), measurability (Gudmundsson et al., 2016; Jackson et al., 2000), transferability (van Oudenhoven et al., 2018), and relevance (Jackson et al., 2000; Niemeijer and de Groot, 2008; van Oudenhoven et al., 2018). The evaluation showed that the indicator is rooted in sense of place scholarship (validity) and optimized for an intended purpose, namely spatial planning. The latter is achieved through the spatially explicit assessment of sense of place. The indicator further proved to be straightforward to apply in empirical studies, by using established methods, such as PPGIS, but also other analogue participator mapping methods (*Article I*). Sense of place data could be analysed quantitatively and qualitatively as shown in *Article I, II and III*. Furthermore, the indicator has been applied in another case study using a different assessment method (interviews including an individual mapping exercise), which demonstrated its transferability. It can be argued that the indicator is relevant for spatial planning, filling knowledge gaps on people-place relationships, integrating local knowledge into the planning process and preventing one-sided developments, and facilitating implementation of planned actions providing results that are close to the citizens' everyday life, co-produced, and tangible in forms of maps (*Article I*). The integration of the

indicator within the Geodesign workshop showed that stakeholders from planning administration were interested, able to work with the indicator, evaluated it positively for gathering spatial information of citizens relevant for planning, and the majority expressed their interest to integrate it in their own work (*Article IV*).

4.2 Application of the meaningful place indicator (*Article II and III*)

The meaningful place indicator has been applied to a PPGIS survey. The following presents and discusses two types of information drawn from the indicator relevant for planning: the meaningful place itself, including types of meanings and attachments (*Article II*), and environmental stewardship behaviour and intentions at these meaningful places (*Article III*).

The PPGIS survey resulted in 1022 valid responses on meaningful places by 480 respondents. Surveys with wrong personal codes (outside the existing code range of 1-3000) in case of the random sample and empty survey were excluded. More than half of the respondents were addressed through the random sampling approach. This survey yielded a total of 561 meaningful places located by 244 respondents. This results in a response rate of 9.2%. In the self-selected sample, 244 respondents located 461 meaningful places. In comparison to overall census data, only the average age of respondents from the self-selected sample corresponds to the census average age. Otherwise, survey respondents from both samples represent relatively more male than female citizens, people with higher income, and older citizens compared to the overall population (Tab.2). This has to be considered when analyzing and interpreting the data, and was presented as such to workshop participants.

Table 2 Comparison of socio-demographic variables between self-select sample, random sample and census data, census data based on Hessian State Agency for Statistics, Wiesbaden, 2019 and 2020, NA=no answer, source: *Gottwald et al, under review, Article IV*

Socio-demographic variables	Self-select sample (N=236)	Random sample (N=244)	Census	
Average age (years)	46.5	55.9	45.4	
Gender (%)	Female	31.8	32.4	50.6
	Male	67.4	67.2	49.4
	NA	.8	1.2	
Income (%)	Under 3200	52.1	44.7	83.4
	3200 and more	38.1	41.8	16.6
	NA	9.7	13.5	

4.2.1 Characterisation of meaningful places

The second article aimed to answer the questions of, first, which meanings and attachments are attributed to meaningful places located by respondents, and second, how physical environment and social-economic variables influence meanings and attachments of meaningful places. Results are briefly presented and discussed here and more detail can be found in *Article II*.

The comparison and correlation of free listed meanings with the CES meanings, shows that forms and processes (Stephenson, 2008), such as natural elements or human activities, are well reflected in the list of CES. In contrast, relationships meanings are not represented within the CES list, specifically well-being, memories, and Heimat. Memories does not show significant correlation to any meaning of the CES list. Well-being correlates significantly positively with nature experience and education, and inspiration; yet these natural meanings are not sufficient to represent well-being which is much more complex and nuanced. Heimat also significantly relates to some CES (cultural heritage, natural significance and social relations), but as in the case of well-being, the meaning of Heimat is not identical and cannot be represented by those CES meanings, deserving to be a proper type of meaning by itself. As a result, a final list of place meanings was compiled (Fig. 8). The most frequently mentioned meanings were recreation, aesthetic appreciation, nature and social relations, which is in line with findings assessments of cultural ecosystem services in Germany (Plieninger et al., 2013). For 94% of meaningful places (with indicated meanings), respondents associated more than one meaning type to a place. This corresponds to findings on the multiple correlations between CES (Plieninger et al., 2013) and the understanding of an interlinked, holistic nature of CES (Bieling and Plieninger, 2013).

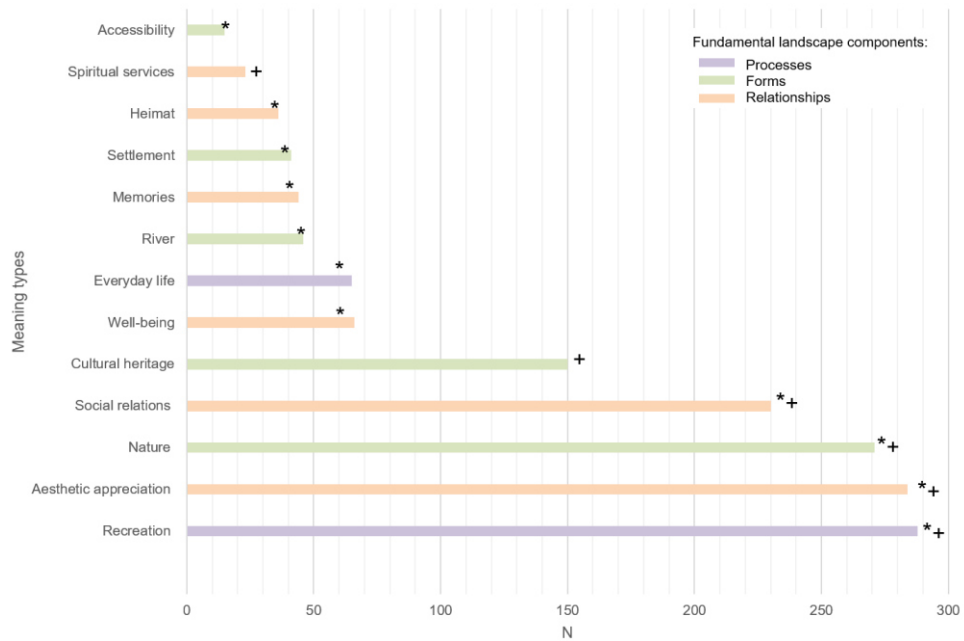


Figure 8 Frequency of place meaning types, note: *based on free listed place meanings, +based on CES place meaning list, +* combination of both, *source: Gottwald et al., under review, Article II*

This study demonstrates that a holistic assessment of both place meanings and attachment is important. For example, place meanings showed significant correlation to land use types and respondents’ personal attributes. Yet, place attachment did not significantly correlate with personal or biophysical attributes, except for distance from home. However, place attachment scores differed between meaning types. Relationship meanings, such as memory and Heimat, and meanings related to practices, such as recreation and everyday life, show higher attachment intensity scores than meanings related to forms, such as settlement, river, or nature. This is in line with studies suggesting meanings as a mediator between place attachment and the physical environment (Stedman, 2003). Looking in depth at the types of meanings gives a more nuanced picture of how people are related to their environment. For example, nature meanings are significantly positively related to different kind of green space, while meanings associated with cultural heritage and social relations are significantly negatively related to these land uses. This adds to studies which found positive relation between green space and sense of community or community attachment (Arnberger and Eder, 2012; Kim and Kaplan, 2004). It further contradicts studies that could not find a relation between neighbourhood greenness and sense of place (McCunn and Gifford, 2014), which may be explained with a lack of detail on the different types of meanings. Place attachment was most intense in close proximity to a person’s home and decreased with increasing distance. Given the assessment context and the

maximum distance of 41km, this finding is similar to other studies showing a U-shaped curve with highest attachment close to home, decreasing intensity at the city or regional scale and increasing intensity at the national or even global scale (Devine-Wright and Batel, 2017; Hidalgo and Hernandez, 2001; Lewicka, 2010).

Further, findings on the relation between types of meanings and sum of meanings to personal attributes lead to the conclusion that individual attributes, which together with place attributes contribute to sense of place (Raymond et al., 2017b), are rather complex character traits and preferences, rather than simple socio-demographic characteristics. For the latter, no association could be found, despite other studies demonstrating relations to the perception of the ecosystem's capacity (Martín-López et al., 2012). Yet, positive significant relations could be found between environmental citizenship and nature related meanings and cultural heritage, between local knowledge and spiritual values, and between environmental local knowledge and the amount of meanings associated to one place.

In summary, the application of the indicator demonstrated that first, the assessment of specific place meaning types is important to better understand relationships between sense of place and socio-economic and biophysical variables. Second, the use of free-listing approaches and an established list of cultural ecosystem services demonstrated that many free listed meanings could be found within the CES list. Yet, relationship meanings, such as Heimat or memories, which appeared relatively often and with high attachment intensity among the free listed meanings were not reflected within the CES meaning list. Third, synergies can be found between the CES concept and the sense of place theory. The CES concept offer experience and expertise for spatial assessments, for example in form of established lists tested in context specific studies (see for a German example Plieninger et al., 2013; Rall et al., 2017), which is lacking in spatial sense of place research. In exchange, sense of place offers a theoretical basis for understanding human-environment relationships (*Article II*).

4.2.2 Meaningful places and their relation to environmental stewardship

Sense of place has shown to be related to environmental stewardship, which in turn is of interest to planners and decision maker to prevent conflicts and initiate collaboration with local citizens. In this part of the dissertation, and particularly in *Article III*, we wanted to expand on the theoretical understanding of the relation between sense of place and environmental stewardship and reflect on its practical application. Therefore, the guiding questions were 1) how

are meaningful places and their respondents characterized based on willingness to engage in environmental stewardship, and 2) how do place characteristics, personal characteristics, and place relations and values explain the presence or absence of local environmental stewardship.

We found that local environmental stewardship, or the willingness to preserve a meaningful place, is a function of people-place relations (strength of attachment and number of perceived values), and the person's capacity to act (as defined by proxy of previous engagement experiences). People-place relations are the most powerful predictors for environmental stewardship, namely the intensity of place attachment, the number of associated meanings, and the presence of nature related meanings. This supports findings from other studies that showed a positive relation between place attachment and environmental stewardship (Devine-Wright and Howes, 2010; Stedman, 2002), as well as between nature attachment and stewardship (Scannell and Gifford, 2010). However, our findings stand in contrast to other studies which focus more strongly on personal characteristics, highlighting that personal and social benefits are a stronger motivator than environment-related reasons (Asah and Blahna, 2012). Our study shows significant relationships between sense of place and the biophysical place attributes, and that the predictive power of personal motivation (e.g., environmental citizenship) is much smaller. These contradictions can also stem from the fact that previous studies on environmental stewardship were lacking an explicit spatial connection (Bennett et al., 2018) or focused on specific environmental stewardship projects (Dresner et al., 2015; Krasny et al., 2014).

In contrast to previous research, and as a main contribution to this field of research, the presented study had a spatial approach using the PPGIS method. Figure 9 presents the spatial distribution of meaningful places, where respondents would act to preserve that place (presented by green circles) and where they would refrain from doing so (red). The figure further highlights the number of meanings assigned to these places for two exemplary map extracts of the study area, showing that in the rural area (right extract) most places contain red circles (no action place), referring to few meanings assigned in relation to the green places. In contrast, in the urban area (left extract), also no action places were associated with multiple meanings. This can be explained with the potential to act in build-up versus open areas, but would need to be looked at in more detail.

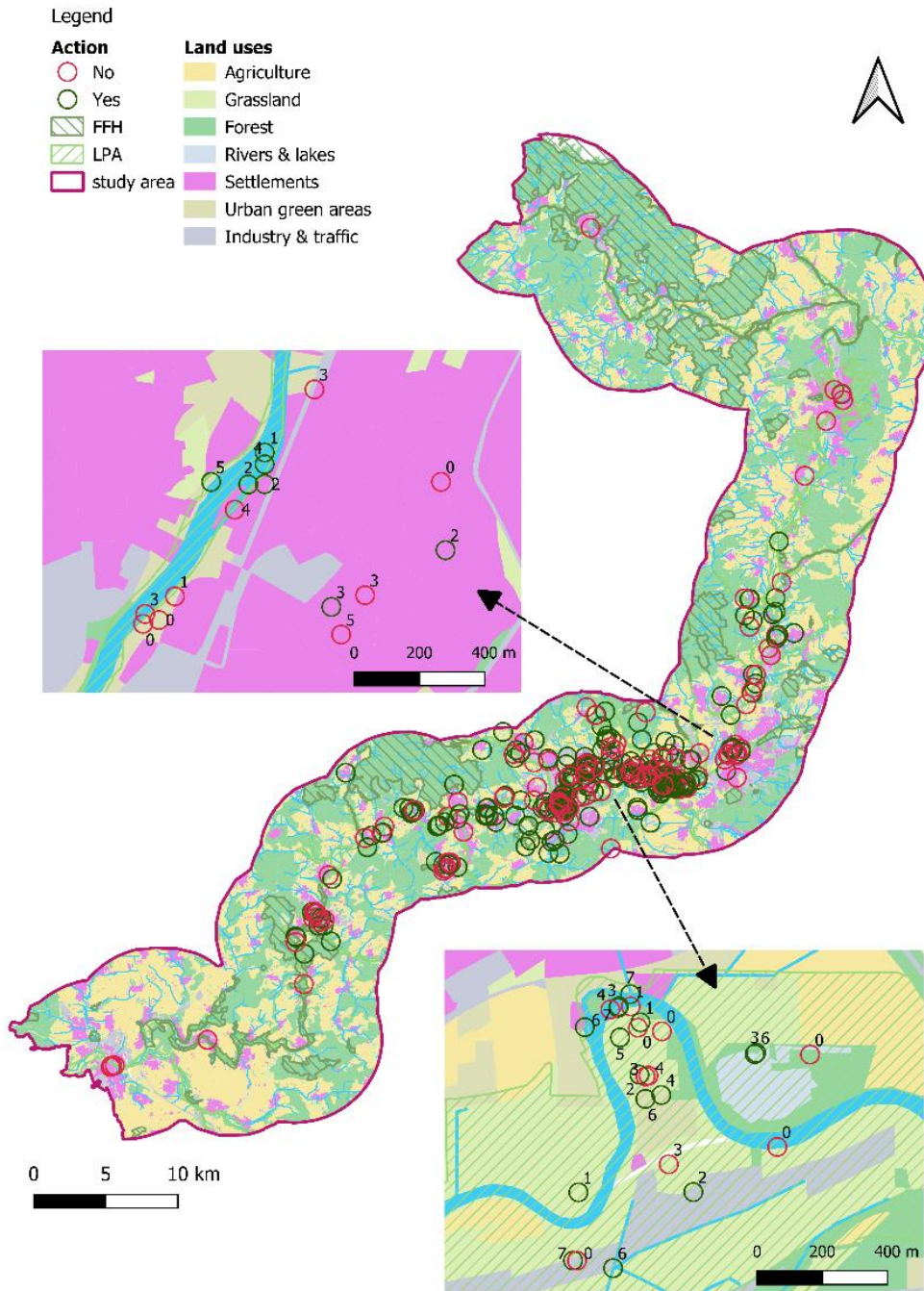


Figure 9 Distribution of action and no action places, the numbers show the amount of values encountered at each place (Gottwald and Stedman, 2020), source: Gottwald and Stedman 2020, Article III

Apart from the spatially explicit assessment, this study provided another unique insight, looking at differences between people who are willing to act at *all* of the places they find meaningful, and people who are only willing to act at some places. For the first group of people, acting at all places, their capacity (experience in engaging in planning), local knowledge and environmental citizenship are the most significant predictors to act at all places (besides place values and relations). For the second group, with willingness to act at selected

places only, the people-place relationship is the only significant predictor. Therefore, only findings from respondents acting at all places supports results of other studies highlighting the importance of actors, capacity and motivation (Bennett et al., 2018).

This subchapter has shown the crucial role of place meanings, which is further illustrated in figure 10. It shows that place meanings, such as the type of meaning and the amount of attributed meanings, are related to all considered variables: physical environment, personal attributes, place attachment and environmental stewardship. It can be seen as a mediator between the physical environment and place attachment, and environmental stewardship, as well as between personal attributes and place attachment, and environmental stewardship if analysed for difference between willingness to act at *all* places and act at selected places. The mediating character of place meanings between attachment and physical characteristics has been highlighted in previous studies (Stedman, 2003). Physical characteristics provide opportunities and limits to create meanings (Ingalls et al., 2016; Stedman, 2003) and place values (Plieninger et al., 2013), but are not a predictor for attachment (Stedman, 2003). Yet, as demonstrated in this study and previous research, attachment shows positive relations to environmental stewardship (Devine-Wright and Howes, 2010; Scannell and Gifford, 2010).

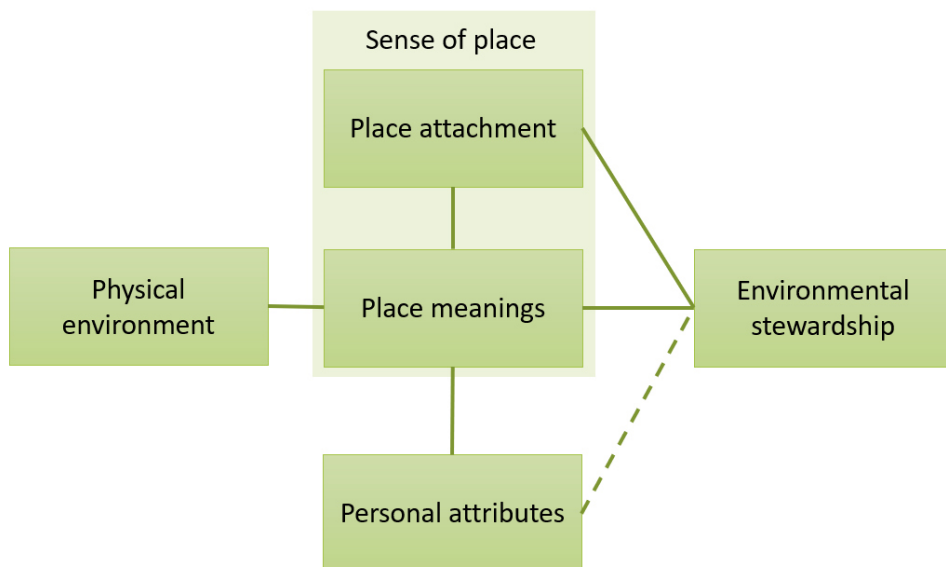


Figure 10 Relation between variables of sense of place, physical environment, personal attributes and environmental stewardship, Note: dashed line - relation only for respondents who are willing to take action at *all* of their located meaningful places

4.3 Integrating sense of place into participatory river landscape designs (*Article IV*)

The previous subchapter has shown the knowledge we were able to gather on people-place relationships, including sense of place and its relation to environmental stewardship. This can indeed be very relevant for planners as argued in chapter 2.2.2. This subchapter illustrates the integration of sense of place information gathered through a participatory mapping process into a Geodesign workshop. Based on these results and insight from literature, we will propose where, how and with which potential benefits sense of place can be integrated in landscape planning processes (*Article IV*).

4.3.1 Integrating sense of place into a Geodesign Workshop

The spatial extract chosen for the workshop included 539 meaningful places located by 292 respondents, considering both sampling approaches, which were used to show participants meaningful places as identified by local citizens, to ask participants to draw coherent clusters of meaningful places, and finally to describe the clusters in terms of meanings and discuss potential development and preservation strategies. We found that (1) meaningful places marked by local citizens highlight areas that would have been overlooked by workshop participants, thus making up for their lack of local knowledge, (2) even though the potential meanings of meaningful places spurred discussion among workshop participants, they would have liked to know more on the specific meaning types at the different places, and (3) despite the newness of the sense of place theory for the workshop participants, the majority considered the information interesting and relevant for the planning process.

Local knowledge is a very important ingredient for successful planning process and cannot be fully provided by external planners (Wöbse, 2004). This study showed that the lack of place-based local knowledge of some participants could be compensated not only by the expertise of some other participants, but also by the sense of place information provided. They were surprised about some locations, where meaningful places clustered, which was expressed through statements such as “this means that they [survey respondents] also move around here because it is green and they can go there” (participant Group B, in relation to meaningful places in river segment 9, Fig.11). Therefore, the workshop results, in forms of maps, contribute to a multi-knowledge evidence base, which arguably enhances the holistic understanding of the landscape (Tengö et al., 2014).

Furthermore, Figure 11 shows the different areas that workshop participants have drawn around spatial cluster of meaningful places, hence considering citizens' subjective people-place relationships. There are some overlaps of meaningful areas between the groups as both workshop groups had received the exact same meaningful place dataset as a basis. The meaning they attributed to these areas were a major point of discussion, for example on the importance of the view to the river giving meaning to places in the city center of Wetzlar (Fig.11, river segment 3, Group B). There are also some differences in the meanings attributed to these highlighted areas, for example in segment 3 (Fig.11), Group A labeled the area as meaningful for recreation and Group B decided that the dominant meaning of this area is around green space and the Lahn floodplain.

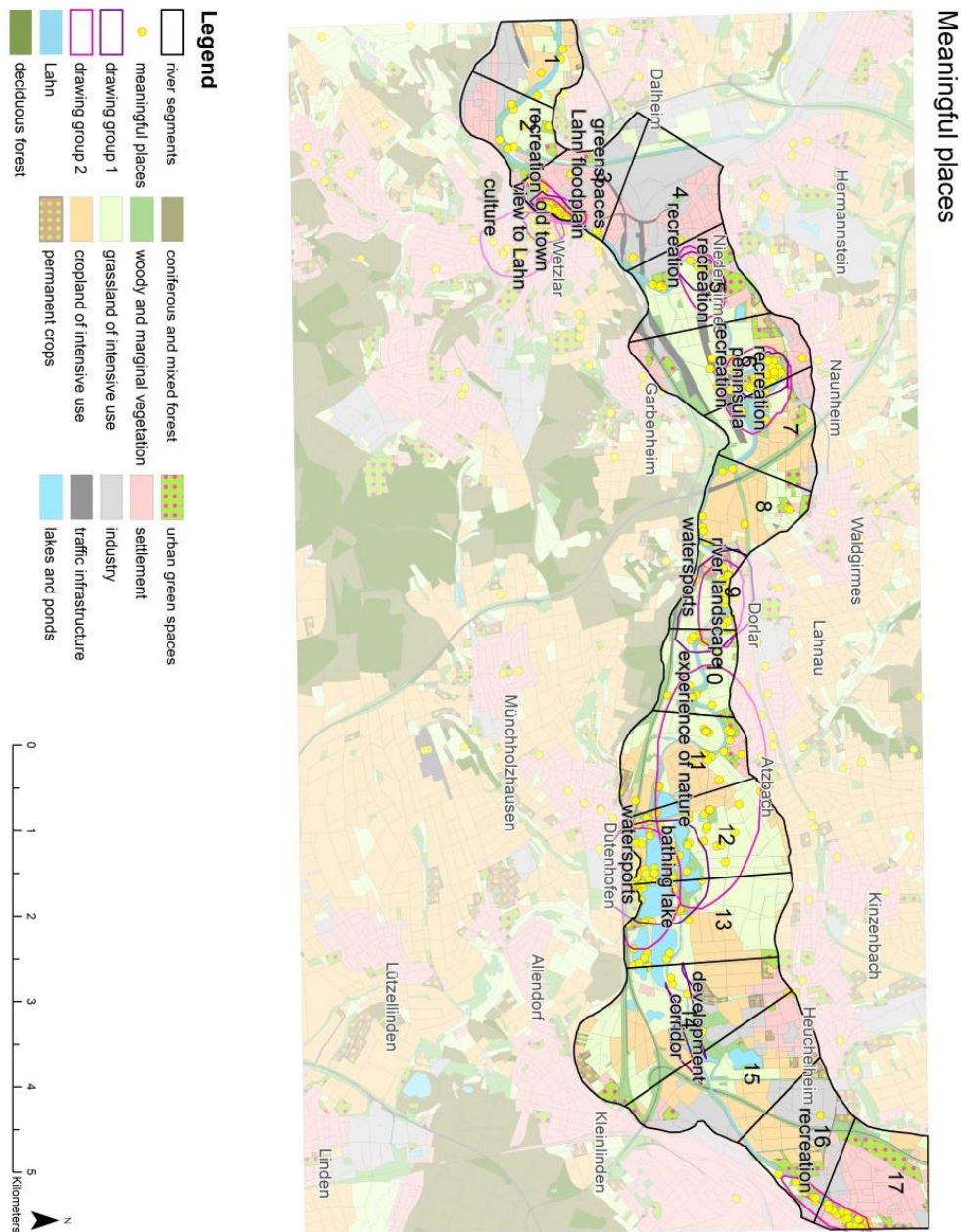


Figure 11 drawing, source: Gottwald et al., under review, Article IV

In conclusion, the integration of sense of place into the workshop was successful, because participants were able to work with the data, the data spurred discussions because participants clearly considered local citizen’s perspective and place relation, and the majority evaluated the received information on sense of place as both interesting and relevant for their work. This encouraged the design of a proposal form integrating sense of place into a landscape planning process.

4.3.2 Proposal of a participatory spatial planning concept for designing NBS in river landscapes – combining instrumental and deliberative approaches

To illustrate the integration of sense of place into a participatory planning process, the example of German landscape planning is used, because it is a long-time institutionalized process, has a long tradition of systematic public participation, and provides the spatial context for the Lahn case study. Landscape planning process can be divided roughly into four phases: (1) scoping, (2) landscape analysis and assessment, (3) development of target concept, (spatial) measures, and (4) final plan proposal, implementation concepts, and monitoring (Von Haaren et al., 2008). Figure 12 presents an illustrative landscape planning cycle, highlighting potential benefits of sense of place integration, by suggesting participatory methods. As outlined in chapter 3.1., the results of this dissertation propose PPGIS survey and Geodesign workshops and their combination as suitable participatory methods.

In the scoping phase (fig.12), the planning context, conditions, problems and objectives are defined, usually in collaboration with environmental authorities (Von Haaren et al., 2008). Sense of place information can support the definition of a spatial scope, as presented in this dissertation, i.e. applying the meaningful place indicator in a PPGIS study. For example, in the previous subchapter, I highlighted how workshop participants used meaningful place information to highlight hotspots of sense of place. Enhanced with additional information on the specific types of meanings (subchapter 4.2.1), sense of place could influence framing the planning problem and highlight the specific meanings planners could shape. It would further allow integrating local citizens at an early stage, which has been shown beneficial for the planning process as it increases social acceptance (Fischer-Gäde, 2016; Müller et al., 2017). Furthermore, this dissertation has demonstrated the close relation between sense of place and environmental stewardship (Gottwald and Stedman, 2020). Integrating sense of place at this early stage, including information on environmental stewardship could provide useful information on potential conflicts and conflictive spatial areas. Hitherto, collaboration processes could be initiated based on this information.

In the assessment phase, sense of place provides a complementary information layer to the usually objective, biophysical indicators that are used (Hermes et al., 2018; Lange and Riedel, 2016). As landscapes and its dynamics are subjectively perceived (Davidson, 2010; Stedman, 2016), systematic and spatially explicit information on sense of place, namely the meaningful place

indicator as proposed in this dissertation, would be beneficial for the improvement of potential conflict assessment between social natural landscape components. Integrating the meaningful place indicator would enable making previously 'hidden' values and perceptions of local citizens spatially explicit. This information can inform the detailed planning process and hence increase the representation of the public in the final plan.

Phase three of the planning cycle, the draft plan is developed based on the previously carried out assessments and includes public participation processes. Here, the Geodesign workshop could provide a platform for local stakeholder, planner and decision maker. Environmental stewardship information could be used here and citizens contacted directly for collaboration purposes through the information they have provide in the survey. Its spatial components are able to directly present the assessed information on sense of place. Further, Geodesign processes have been shown to manage potential boundaries between stakeholder, as they are able to translate different types of information and jargon into spatial information, enhance communication between the participants and provide objective georeferenced information mediating conflicts (Gottwald et al., 2020a, *Article VI*, 2020b, *Publication V*).

The final plan proposal would need to integrate the information of sense of place that has been assessed and considered in the previous steps, including measures to address potential conflicts. This could strengthen the identification with the plan and hence decreases opposition against it. Information from the PPGIS survey could be used again for implementation concepts of specific actions, which could then be used for communication and directly address the conflicts arising through impacting areas with strong sense of place. Here as well, information on environmental stewardship could be used to foster collaboration with the public. Finally, a continuous assessment of sense of place could provide insights on the impact of the specific actions on people-place relationships and be used to adapt the plan in next iterations.

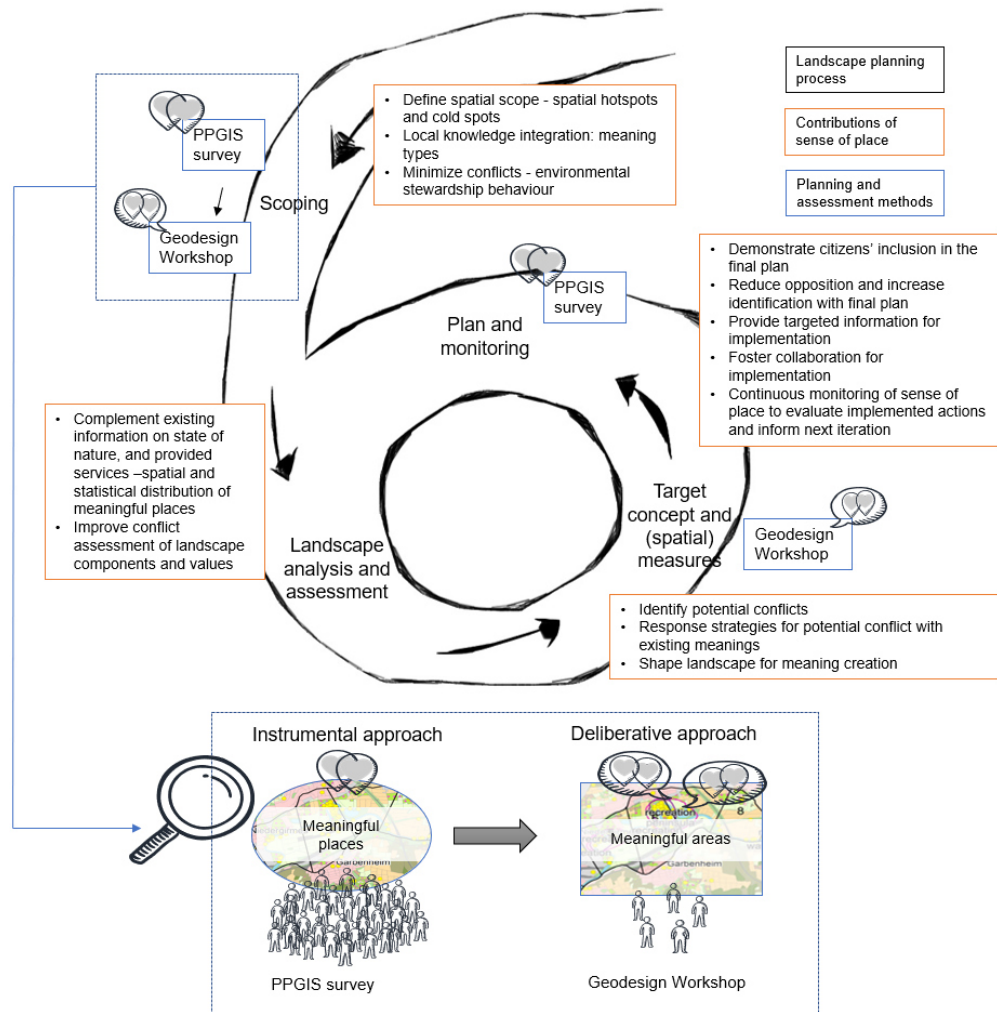


Figure 12 Model of landscape planning process, including contribution of sense of place and potential planning and assessment methods, based on (Lange and Riedel, 2016; von Haaren et al., 2016; Von Haaren et al., 2008), *source: Gottwald et al., under review, Article IV*

5. Conclusions

This dissertation presented the development and application of a spatial indicator for an assessment of sense of place. Furthermore, the work illustrated and applied the indicator and discussed its integration in a planning process. The methodology, results and discussion sections were mainly based on four key articles attached in the appendix, but also influenced by findings and insights of eight additional articles and book chapter written and partly published within the period of this dissertation. In the following, I will reflect on the main theoretical and methodological contributions of this dissertation within the research field of people-place relationships, and on practical applications. Furthermore, the process of this dissertation does not feel like a closed case but rather opens up many new research directions, which use the presented findings as a point of departure. These will be briefly presented in the second part of this conclusion.

5.1 Contributions of this dissertation

This dissertation contributes mainly to place research, research on sense of place and people-place relationships. It addressed existing knowledge gaps, such as the lack of understanding of people's emotional connectedness to river. In response, this dissertation provides insights on citizens' sense of place in the Lahn river landscape and how sense of place relates to biophysical and personal attributes (*Article II*), as well as local environmental stewardship (*Article III*). Moreover, it advocates for a stronger focus on place meanings in sense of place research, as these have shown to occupy a central role in assessing sense of place and relating it to the social and environmental context, as well as to environmental stewardship (*Article II and III*, chapter 4.2).

Regarding the methodological contribution, the dissertation introduces a methodological approach to spatially and holistically assess sense of place, which is valid, measurable, transferable and relevant for planning practitioners (*Article I*). The meaningful place indicator includes the two main sub concepts of sense of place, namely place attachment and place meanings. Using a

participatory mapping method, respondents could rate their place attachment intensity for the different dimensions and items tested and established through various previous studies and additionally indicate their specific place meanings, combining free-listing and established CES lists (*Article II*). Additionally, it provides an opportunity to refer to any specific place of the individual beyond predefined administrative borders, such as neighborhood limits or parks (chapter 4.1).

Finally, the dissertation provides a proposal of how, where and with what potential benefits sense of place can be integrated into spatial planning, using German landscape planning as example, which was illustrated with a specific empirical process of integrating sense of place in a participatory planning workshop (*Article IV*). Based on the results presented and discussed in this dissertation, I would like to derive five concrete and actionable recommendations for landscape planners and managers (Fig. 13). First, planners should make a conscious decision on integrating sense of place. While the advantages have been highlighted in this dissertation (*Article I*, chapter 2.2.2) such integration of sense of place requires additional work and particular skills, depending on the chosen method. Therefore, planners should consider the specific focus of the project: Projects that change the landscape in ways impacting how people can use and experience their environment should consider the effort of implementing sense of place information. For example, plan proposal that consider changing accessible elements to the river would benefit from the integration of sense of place. For example, the constructing of longitudinal dams have shown to impact place attachments (Ganzevoort and van den Born, 2018; Verbrugge et al., 2017). In case planners decide to work with the methods presented in this dissertation (digital and map based), resources, skills and institutional motivation should be present and made available in order to successfully assess and integrate the information (Kahila-Tani et al., 2019; Kahila et al., 2015).

Second, planners should assess and integrate sense of place as early as possible in the process. Sense of place information should be assessed in the earliest stages, as it can already inform the scoping process (*Article IV*, chapter 4.3). Likewise, an early integration of stakeholders and their values has shown to increase the social acceptance (Müller et al., 2017).

Third, planners should consider the appropriate methodological approach for the assessment and integration of sense of place. There are different methods for assessing sense of place, for an overview see Raymond and Gottwald (under

review), *Publication IX*. The meaningful place indicator, developed in this dissertation has shown to be measurable through digital (PPGIS) and analogue (interviews with mapping exercise) methods (Knaps et al., under review, *Article I*). Using map based, digital and participatory methods as presented in this dissertation offer a lot of advantages: they are spatially explicit, offering a good fit with current planning practices, and provide a simple, communicative tool; in particular, PPGIS tools are able to reach a wide audience helping to integrate people which are underrepresented in other formats by providing a non-confrontational platform, which is time and place independent (Garcia et al., 2020b, *Article XIII*). Solely assessing sense of place through for example PPGIS is not sufficient, it needs to be combined with other participatory methods (Kahila-Tani et al., 2019), such as the presented Geodesign workshop (*Article IV*).

Fourth, planners should pay attention to a transparent and inclusive process of assessment, publication, and integration, including a geographic and socio-economic representativeness (Kahila-Tani et al., 2019). To do so, a random sample could be drawn, making use of a reliable data source, such as communal registers. Otherwise, an open invitation to the public could be published specifically at places reaching people that are usually underrepresented, such as younger people and minorities. In case of employing digital methods, potential challenges arising through the digital divide should be considered (Garcia et al., 2020b, *Article VIII*; Kahila-Tani et al., 2019). This can be done by adapting the assessment tool, such as the PPGIS survey, to the intended user groups (Brown and Kytä, 2018), for example by taking into account the size of letters or using intuitive symbols for different age groups (Gottwald et al., 2016). Further, the data should be made available to the public and provided in a format which fits the purpose and receivers, for example using easy to read hot spot maps.

Fifth and finally, planners should use external support to complement their own skills and resources. The analysis of sense of place information can reach from geostatistical to statistical analyses, including descriptive statistics and geo-visualizations, as well as more exploratory statistics (see e.g., *Article II* and *III*). Further, these need to be integrated into participatory processes (*Article IV*). There are companies specialized in leading through modern participation process using PPGIS methods, as for example demonstrated in Gottwald and Helle (2018).



Figure 13 Actionable advice for planners around using and integrating sense of place in planning processes

5.2 Future research directions

Finally, I would like to highlight two major future research directions that directly build on the theoretical and methodological contributions of this dissertation. The first is related to the further development of the meaningful place indicator, drawing on results gained from the application in the presented case study and proposing new ways for integrating diverse geometries, as well as alternative assessment forms, such as social media bid data. The second potential future research direction challenges dominant assumptions on sense of place, in particular the essentialist character, proposing a progressive approach which considers mobile life styles.

First, the meaningful place indicator and its application could be further developed. Integrating the findings from *Article II* on the final list of place meaning types, the provided list of place meanings in the survey, which had been based on CES only, could be extended by relationship meanings. This has been done in the realm of the transfer case study of the PlanSmart research project in an ongoing study in Costa Rica on environmental problems related to the river Tárcoles. Further, the geometry needs to be acknowledged more explicitly. In spatial terms, people are not necessarily connected to a single point, but to a more extended area or route. The spatial scale can vary from very small, such as small objects, to very large, such as the whole planet earth (e.g., Altman & Low, 1992; Canter, 1997; Lewicka, 2010; Tuan, 1977). While the presented dissertation was able to respect the specific location of the meaningful

place, it did not consider the spatial extension or scale of attachment. To do so, there are several methods available to assess sense of place across different geographic scales, such as participatory mapping, focus groups or spatial navigation methods (Raymond and Gottwald, under review, *Publication IX*). Further, the spatial extension could be integrated in the analysis of the data set presented in this study, which assessed the actual geometry for every meaningful place, by asking if the place represents a single point, a route or an area. Finally, digitalization provides yet another set of methodological possibilities to explore sense of place, for example using mobile phone application and big data from social media platforms. Results of one of the very few studies that used digital devices to measure physical activities in combination with GPS devices showed that participants took detours in their daily routine to include places they feel attached to (Bell et al., 2015). Studies using social media data, such as geotagged photographs, focus rather on cultural ecosystem services (see for example Guerrero et al., 2016; Oteros-Rozas et al., 2017). Yet, within this dissertation we could show the tight relation between CES and place meaning types related to forms and processes. This could be a starting point for investigating more in depth how geotagged social media data could be used to explore sense of place.

Second, until recently most research on sense of place, including this dissertation, focused on the premise of static and immobile lifestyles, assuming an important role of continuity, enclosure, and the so-called *genius loci* for the creation of place meanings. This theoretical approach, also called essentialism (M. Lewicka et al., 2019), has been recently contested, because societies are becoming more mobile, including diverse and new types of mobility (Büscher and Urry, 2009), facilitated through digital advancements, and in consequence, modes of attachment change. In response, studies have highlighted attachments and meanings created and understood through more progressive approaches (Di Masso et al., 2019; Maria Lewicka et al., 2019). These account for a dynamic lifestyle and assume mobility as the natural human condition (Massey, 1991), understanding places as open, modern, and heterogenic in their physical, social and historical features (Maria Lewicka et al., 2019). Di Masso et al. (2019) introduced the conceptual framework of 'Fixity and Flow', describing the differences between spatially static and temporally stable aspects of relations to the place, hence an essentialist perspective. In contrast, the 'Flow' approach accounts for spatial mobility and temporal changes of relations to the place. In line with this, anti-essentialist perspectives on people-place relations considers temporal and spatial changes, as well as physical and social heterogeneity of

places. The relationship between mobility and sense of place is complex, it can be seen as opposing or complementary (Gustafson, 2001). In line with this, anti-essentialist and flow meanings can either contrast or complement the essentialist of a Fixity perspective. Substantial knowledge gaps exist regarding scientific theoretical understanding and empirical evidence on the intersection between mobility patterns and sense of place. Empirical studies are still scarce, that (1) consider people's everyday life settings and environments, (2) combine both essentialist and progressive approaches as complementary, and (3) account for the different types of mobility, such as corporal travel, physical movement of objects, imaginative travel, virtual travel and communicative travel (Büscher and Urry, 2009; Di Masso et al., 2019). Until now, theoretical advances, such as the proposed framework by Di Masso et al. (2019), are missing empirical evidence and provide ample opportunities for further theoretical development. The meaningful place indicator presented and applied within this dissertation could be applied to integrate people's every day environments into the assessment of sense of place. Due to their place-based focus, the here presented methods (PPGIS and Geodesign) are suitable to assess not only sense of place, but also integrate mobility aspect.

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Eidesstattliche Erklärung/ Declaration of authorship

Hiermit versichere ich, die vorliegende Dissertation selbständig angefertigt und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt zu haben. Die Arbeit wurde noch nicht als Dissertation oder als Prüfungsarbeit vorgelegt.

Teile der Dissertation wurden mit Zustimmung des Betreuers Prof. Dr. Christian Albert in folgenden Beiträgen vorab veröffentlicht:

I hereby assure you that I have written this dissertation independently and that I have not used any other sources and aids than those indicated. The work has not yet been submitted as a dissertation or as an examination paper.

With the consent of the supervisor Prof. Dr. Christian Albert, parts of the dissertation were published or submitted in advance:

Knaps, F., **Gottwald, S.**, Hermann, S., Albert, C. (under review). Using Meaningful Places as an Indicator for Sense of Place in Spatial Planning. Submitted to Ecological Indicator (Mai 2020)

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Dies betrifft auch weitere Artikel und Buchkapitel, die im Rahmen der Doktorandenausbildung angefertigt und veröffentlicht bzw. zur Veröffentlichung eingereicht wurden, auf welche im Rahmen dieser Doktorarbeit Bezug genommen wird, die jedoch nicht Kernartikel der vorliegenden Dissertation sind:

This concerns as well further articles and book chapters, which were written and published in the realm of the PhD period, are referenced within this dissertation, but are not considered key parts of the dissertation:

Gottwald, S., Janssen, R., & Raymond, C. (2020). Can Geodesign Be Used to Facilitate Boundary Management for Planning and Implementation of Nature-based Solutions? In *Modelling Nature-based Solutions* (pp. 305–340). Cambridge University Press. <https://doi.org/10.1017/9781108553827.010>

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APPENDIX

Using Meaningful Places as an Indicator for Sense of Place in Spatial Planning

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Keywords:

Sustainable spatial planning, sense of place, public participation GIS, qualitative methods

ABSTRACT

Sense of place – i.e. citizens’ interpretative perspective on and (often emotional) reaction to a location – is increasingly considered in academic literature as a promising factor to support sustainable spatial planning. However, utilizing sense of place for practical planning is challenging, due to a lack of coherent conceptual understanding and a wide range of assessment methods. Furthermore, recommendations how to integrate sense of place in practical planning often remain vague. To facilitate its planning integration, this paper suggests an indicator for sense of place called “meaningful places”. Meaningful places are defined as spatial environments to which i) descriptive meanings (e.g., series of adjectives, descriptions of the place character, symbolic attributions) are ascribed and ii) evaluative attachments (place dependence, place identity) are tied. We applied the indicator in two case-studies using different operationalizations and assessment methods: In the first case, semi-structured interviews in combination with a simple mapping method were used to analyze participants’ “home-regions”. Results revealed diverse but overlapping locations characterized as aesthetic, distinguishable/different from others, close to nature, and quiet. Participants underlined the respective traits by referring to landscape, land-and water-use, settlement structures, and history. In the second case, a public participation GIS (PPGIS) survey was conducted and yielded insights into the spatial distribution of meaningful places. Results reflect a wide range of place meanings which are linked to, e.g., activities carried out at that place, aesthetic place qualities, or feelings of well-being. Furthermore, participants expressed specific dimensions and intensities of emotional connections (place attachments). Taken together, our empirical results underline the indicators strengths of uncovering the spatial dimension of peoples’ sense of place and to display it on maps. The indicator is easy to measure, transferable to varying spatial scales (local and regional), environmental contexts (rural and (sub-)urban areas), and planning contexts. Finally, we present precise advice how data about “meaningful places” can contribute to filling knowledge gaps in planning, preventing one-sided development, and facilitating effective implementation.

1. Introduction

With the emergence of sustainability as a dominant normative paradigm in the 1990s, the ambit and objectives of spatial planning have widened (Næss, 2001; Allmendinger, 2017). Due to this broadened scope, the inclusion of different views and voices as a foundation for decision-making became essential (Berke, 2002; Valencia-Sandoval et al., 2010) as it helps *filling knowledge gaps* (Reed, 2008; Hage et al., 2010; von Haaren et al., 2016), *preventing one-sided development* (Sisto et al., 2018), and *facilitating effective implementation* (Albrechts, 2004; de Vente et al., 2016; Reed et al., 2018). In this regard, incorporating sense of place – i.e. citizens’ interpretative perspective on and (often emotional) reaction to a location (Hummon, 1992) – has gained increasing importance in academic literature (e.g., Grenni et al., 2020). Sense of place is discussed as a promising planning factor for the following reasons:

- It *fills knowledge gaps* by providing in-depth information about a specific kind of often neglected subjective

ORCID(s):

11 environmental values (Stedman, 2016; Arias-Arévalo et al., 2017; Ingalls et al., 2019), which in turn enables an
12 extended understanding of place related conflicts (Manzo and Perkins, 2006; Kirkpatrick et al., 2018; Clermont
13 et al., 2019; Davenport and Anderson, 2005) and stakeholders' (expected) supportive or hostile behavior towards
14 planning activities (Gottwald and Stedman, 2020; Mullendore et al., 2015; Enqvist et al., 2019).

- 15 • It *prevents one-sided spatial development* as it allows planners and decision makers to determine new planning
16 priorities against the backdrop of citizens' subjective environmental values (Smith et al., 2011; Marshall et al.,
17 2019).
- 18 • It *facilitates implementation* because stakeholders and residents are more likely to (actively) support planning
19 when they feel that their valued places are at stake (Höppner et al., 2008; Walker and Ryan, 2008; Lokocz et al.,
20 2011; Soini et al., 2012; Chapin and Knapp, 2015).

21 However, utilizing sense of place in practical spatial planning turns out to be challenging. First, sense of place is
22 a dimension of peoples everyday world (Hummon, 1992) and dealing with such multifaceted social phenomena is no
23 part of planners core expertise. Second, sense of place scholars use a wide range of assessment methods, including
24 qualitative, quantitative, map-based, photo-based as well as mixed approaches (Lin and Lockwood, 2014). The choice
25 of methods, in turn, relates to various sense of place understandings as can be observed in general (Nelson et al., 2020)
26 but also in planning-related sense of place studies (Verbrugge et al., 2019). Moreover, the lack of coherent conceptual
27 understanding is accompanied by a confusing field of similar and overlapping concepts such as place attachment, place
28 identity, sense of belonging, and topophilia (this pluralism is redundantly and often superficially reviewed in a myriad
29 of papers; for a helpful overview see Sebastien, 2020). Third, recommendations how to integrate sense of place in
30 practical planning often remain vague. In combination, these three obstacles may contribute to planners' restraints in
31 using sense of place in their daily routines. Furthermore, they illustrate a need for understandable and more simplified
32 approaches to better harness the potentials, sense of place provides to sustainable spatial planning. In line with this,
33 Masterson et al. (2017) suggest to develop indicators to make this phenomenon tangible and more measurable.

34 In the fields of planning and resource management, using indicators is a widely accepted approach for simplified
35 measurements of complex social-ecological phenomena (van Oudenhoven et al., 2011). Indicators can be defined as
36 a "limited set of measurable parameters to make an assessment of an entity that is not directly measurable" (Turnhout

et al., 2007, p.62). Early indicators primarily reflected on environmental conditions (structures, compositions, functions), causes of change, and change impacts (Niemi and McDonald, 2004; Heink and Kowarik, 2010). Recently, a growing body of literature investigated holistic indicators also taking into account social, economic and cultural values (Jørgensen et al., 2013). Adopting a holistic perspective, we consider sense of place to be a value of social-ecological systems (see also Arias-Arévalo et al., 2017) which can be assessed using indicators.

According to our knowledge, a spatial indicator to effectively assess sense of place and to facilitate its integration into planning has not yet been developed. Therefore, the aim of this paper is to propose such an indicator and to demonstrate different ways for its measurement. As shown in table 1, academic literature provides valuable benchmarks (understood here as a range of values describing a desired condition) of indicators. Referring to these benchmarks, our objectives are (i) to propose an indicator for sense of place based on a strong scientific basis (validity) and optimized for spatial planning applications (intended purpose), (ii) to give evidence that this indicator is measurable (measurability) and can be applied at different spatial scales (transferability) by presenting results from two case studies, and finally (iii) to critically reflect upon the indicators relevance for the planning practice.

Table 1
Benchmarks of environmental indicators as discussed in academic literature

Category	Description	Taken from
Validity	The indicator exhibits a strong scientific basis	Niemeijer and de Groot (2008); van Oudenhoven et al. (2018)
Intended purpose	An indicator must be optimized for an intended purpose	Dizdaroglu (2017); Niemeijer and de Groot (2008); van Oudenhoven et al. (2018)
Measurability	The indicator is straightforward to measure using standard methods (novel methods need evidence of effective performance)	Gudmundsson et al. (2016); Jackson et al. (2000)
Transferability	The indicator is applicable at different spatial scales	van Oudenhoven et al. (2018)
Relevance	The indicator addresses information needs of decision makers, policy actors, and affected stakeholders	Jackson et al. (2000); Mueller and Schade (2012); Niemeijer and de Groot (2008); van Oudenhoven et al. (2018)

The paper is structured as follows: The next section (2.1) revisits current literature and provides conceptual foundations from relevant strands of sense of place research to ensure the indicators validity. Subsequently, a sense of place indicator called “meaningful places” is developed from a spatial planning perspective (intended purpose; section 2.2). This indicator is applied in two case studies that differ in their spatial scale, operationalization and methodical approaches (section 3). In the discussion (section 4), we reflect upon the indicators’ spatial explicitness, measurability,

55 transferability, and relevance for spatial planning. A conclusion (section 5) highlights our core findings and presents
56 proposals for further research.

57 **2. Meaningful places: An indicator for sense of place in spatial planning**

58 **2.1. Conceptual foundations from a spatial planning perspective**

59 In a somewhat ironic way Stedman (2008, p.62) made the point, that “gone are the halcyon days in which a sense
60 of place researcher or theorist could label a section ‘literature review’ and thus encircle much of what has been written
61 about sense of place”. The diversity of scholarship in this field requires a critical positioning from the outset (Williams,
62 2014b). Guided by the intended purpose of a spatial planning application, we focus on sense of place research closely
63 related to planning, natural resource management and social-ecological systems research (for a useful overview on the
64 different strands in sense of place scholarship see Trentelman, 2009). Following this line of thinking, sense of place is
65 understood as a complex phenomenon of human consciousness linked to external environmental stimuli and expressed
66 as a perceived importance of a specific place-relation (Stokowski, 2008). As it relates to the consciousness, each
67 persons sense of place is fundamentally unique (Scannell and Gifford, 2010). The external stimuli – or rather sources of
68 sense of place – originate from both the physical and social environment. The physical environment contributes to sense
69 of place basically through two mechanism: i) directly, as raw material and ii) indirectly, by enabling and constraining
70 experiences (Masterson et al., 2017; Stedman, 2003), whereas the latter also depends on personal characteristics and
71 abilities (Raymond et al., 2017). Social influences include (social) conventions for defining and regulating person-
72 place relationships in a given context (e.g., in a specific group, such as circles of friends, acquaintances, hunters, real
73 estate developers; Kühne 2018; Russ et al. 2015; Gustafson 2001). These shared and often unconscious interpretation
74 templates are conveyed through discourse and interaction (Di Masso et al., 2014), shaped by wider cultural meanings
75 (Horlings, 2015) and act as a filter for personal perceptions (Stokowski, 2008).

76 Further core assumptions in the relevant strand of research relate to the concepts’ multiple sub-dimensions, resulting
77 from the need to (analytically) divide the complex phenomenon in measurable core constructs. Often referring to Tuan
78 (1975), it is widely accepted that sense of place consists of meanings and attachments. Place meanings are descriptive
79 and can be thought as beliefs about the nature of a place, basically answering the question “what kind of place is this?”
80 (Stedman, 2008). Their form can range from simple series of adjectives (e.g., polluted, warm) to complex descriptions

81 of the place character and symbolic attributions (e.g., place as home or escape; Masterson et al., 2017). Due to the
82 complex interplay between social influences and personal interpretations, the same physical environment can carry
83 multiple meanings (Cervený et al., 2017). Nevertheless, as Masterson et al. (2017) point out, it is possible to analyze
84 place meanings because their variations are rather systematic and patterned than random. Because exploring place
85 meanings necessitates an in-depth understanding of people's relationship to a location, qualitative methods are most
86 commonly used (Lewicka, 2011).

87 Place attachments are evaluative ties to a location based on assigned meanings (Stedman, 2008) and can be further
88 distinguished into place identity and place dependence. Place identity refers to a substructure of individual personalities
89 which is defined in relation to spatial settings (Peng et al., 2020). Having a strong place identity means – to put it less
90 abstract – that a person distinguishes himself from others by (amongst other things) references to a location which is
91 often accompanied by emotional ties (Cuba and Hummon, 1993; Kyle and Chick, 2007). Place dependence reflects
92 the perceived ability of a setting to facilitate goal achievement and to satisfy important needs (Williams, 2014a). The
93 degree to which specific places (through their meanings) contribute to place identity and place dependence is often
94 measured using quantitative instruments (Farnum et al., 2005; Stedman, 2016).

95 Finally, and with the risk of being redundant, it should be emphasized that the separation into place meanings and
96 attachments is entirely analytical. Ascribing meanings to a place and becoming attached are indispensable, interwoven
97 and parallel processes (instead of running one after another). For example, ascribing the symbolic place meaning to
98 be “my home” includes a personal appropriation through which the location becomes an object of subjective self-
99 definitions (place identity).

100 **2.2. Towards a sense of place indicator for spatial planning**

101 Spatial planning is characterized by a place-focused mindset and the use of spatially precise data (von Haaren
102 et al., 2019). With regard to place attachments, Brown et al. (2015, p.51) argued that until it “can be meaningfully
103 rendered on a map, it will not be influential for land use planning and decision support”. Following this argument, an
104 indicator for sense of place has to be spatially explicit, i.e. it has to (graphically) represent – at least approximately – the
105 positions and demarcations of spatial environments, which are infused with meanings and attachments as presented in
106 section 2.1. Consequently, we define an indicator for sense of place called “meaningful places” as follows: Meaningful

Meaningful places as an indicator for sense of place

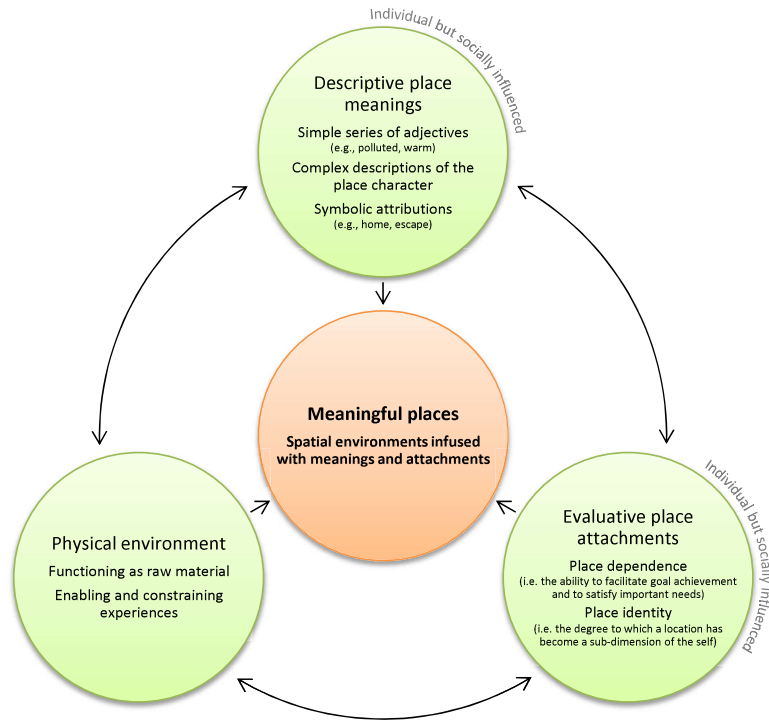


Figure 1: Core dimensions (green) of meaningful places (orange), an indicator for sense of place

107 places are spatial environments – in the physical world as well as in abstracted representation on maps – to which i)
108 descriptive meanings (e.g., series of adjectives, descriptions of the place character, symbolic attributions) are ascribed
109 and ii) evaluative attachments (place dependence, place identity) are tied. Or more condensed and referring to the
110 wording of early sense of place research: meaningful places can be understood as both a center of meaning and a locus
111 of attachment (Williams, 2014b; Raymond et al., 2017). Taken together, this indicator simplifies the complex sense
112 of place concept by a reduced level of abstraction and a focus on its spatial dimension. The core dimensions of the
113 developed indicator are illustrated in Figure 1.

114 **3. Applying the developed indicator: Evidence from two case studies**

115 **3.1. Case study descriptions and methods used**

116 The first case study area comprised the north German city of Lübeck, close to the Baltic Sea (Figure 2 on page 9).
117 Lübeck's city planners were interested in sense of place on a regional level, including the urbanized core areas and
118 the less populated urban catchment areas. More precisely, the meaningful places approach was used to identify spatial

119 environments on a regional level to which residents ascribe the symbolic attribution to be their personal “home-region”
 120 (descriptive place meaning). These places are assumed to be relevant components for individual place identities (eval-
 121 uative place attachment)¹. Further attention was devoted to the perceived character of these locations (descriptive place
 122 meanings). Meaningful places were measured using semi-structured face-to-face interviews, lasting approximately 45
 123 minutes. We involved 23 respondents of different age, origin, and background (experts from private economy, interest
 124 groups, politics, and public administrations but also laypersons; further participant characteristics are shown in Ap-
 125 pendix A). During the interviews, participants were asked to sketch on a prepared, georeferenced map what they have
 126 in mind when they think of their “home-region”. Further interview questions explored the character of these places
 127 (for the main questions used in the interviews see Appendix A). For data analysis, participants “home-regions” were
 128 digitized and overlaid using ArcGIS (version 10.6). The recorded interviews were transcribed verbatim and analyzed
 129 by conducting a qualitative content analysis (Schreier, 2012) with the help of MAXQDA (version 12).

130 The second case study was located at the Lahn River in central Germany (Figure 3 on page 11). To support a
 131 regional integrated EU Life project (Living Lahn - Lila) in the development of a sustainable river concept, different
 132 scientific methods and interventions (survey, interviews, workshops) were used. One of the methods consisted of a
 133 PPGIS survey which results were later integrated in workshop collaboration with Lila. Specifically, an online PPGIS
 134 survey was developed to assess meaningful places integrating its descriptive and evaluative dimensions. 3000 people
 135 were invited by mail (including one reminder). Finally, 244 participated (response rate = 9.2% after eliminating invalid
 136 responses such as empty surveys and incorrect codes) with a dominance of older age groups and male respondents
 137 (further participant characteristics are shown in Appendix A). In the PPGIS study, participants marked their meaningful
 138 places on a map. After each location, they were asked i) to describe why the located place is meaningful to them
 139 (descriptive place meanings), and ii) to value nine place attachment items (Williams and Vaske, 2003; Jorgensen and
 140 Stedman, 2006) on a 5-point Likert scale ranging from “strongly agree” to “strongly disagree”. To further account for
 141 the highly variable spatial extent of meaningful places, respondents were iii) able to specify the geometric shape of
 142 their meaningful place which could be either a point (such as a barbecue spot or small beach), an elongated course
 143 (such as a stretch of the river) or a larger area (such as a forest or part of the city). For the scope of this article, the
 144 spatial analysis and visualization assumed an equal spatial extent for each meaningful place indicated and did not

¹However, the strengths of place attachments were not further measured

145 account for potential differences in the shapes (e.g. elongated vs. coherent areas). Data analysis was conducted by
 146 qualitative content analysis using OpenCode (version 4.03), descriptive statistics in IBM SPSS Statistics (version 26),
 147 and GIS visualization using QuantumGIS (version 3.4.10). Meaning categories were formed deductively following
 148 the cultural value model by Stephenson (2008). Contrasts of both case study approaches are highlighted in table 2. It
 149 shows that both approaches not only differ in their scale and methods but also in their operationalization of meaningful
 150 places.

Table 2
 Contrasts of both case study approaches

Case study	Lübeck	Lahn
Scale	Regional	Local to regional
Operationalization	Narrow approach: Spatial environments perceived as "home-regions" and their perceived character	Inclusive approach: Spatial environments related to the Lahn river and its surrounding landscape to which various meanings are ascribed and attachments are tied
Methods	Simple analogue mapping technique, semi-structured interviews, no measurement of the attachments degree, N=23	Public participation GIS (PPGIS) allowing open and closed questions to assess place meanings and to measure the attachments strength, N=244

151 3.2. Results

152 3.2.1. Meaningful places in the Lübeck study

153 Participants mapped diverse areas individually perceived as "home-regions". The spectrum ranges from small-
 154 scale places encompassing only sub-parts of Lübeck to areas going far beyond the city borders. Most "home-regions"
 155 include Lübeck's urban center, less urbanized areas adjacent to the administrative boundaries and coastal areas (Figure
 156 2). Lübeck's most southern parts seemed to be less important. The interviews confirmed that these spatial environments
 157 are components of participants' place identity and personality. They were described as "my home" (I19)², while others
 158 claimed they "couldn't live anywhere else" (I9). Furthermore, participants expressed emotional connections by, e.g.,
 159 making the point to be "proud (...) of Lübeck as a whole" (I14) and (in times of absence) to "miss this piece of home,
 160 where you are rooted" (I20).

161 When asked about the place character of the respective "home-region", participants commented in diverse ways.
 162 Nevertheless, it was possible to identify four categories of place character descriptions. As shown in table 3, partici-

²The designation "I" in combination with a number stands for one of the 23 respondents

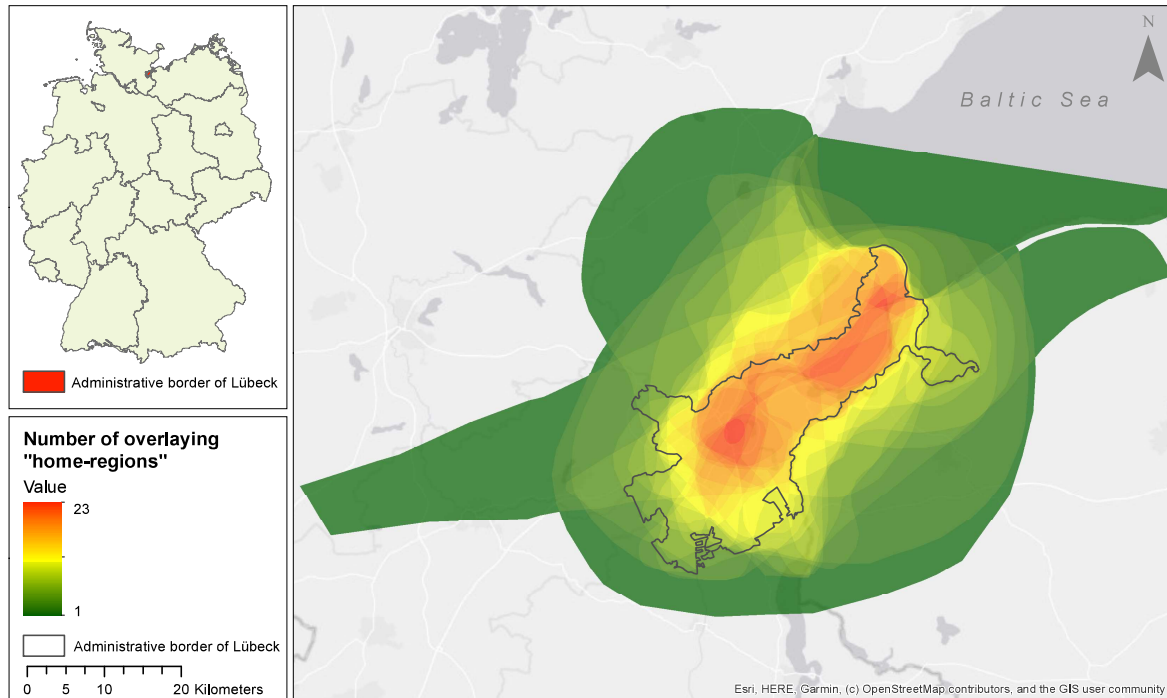


Figure 2: Location of the study area (left) and overlay analysis of participants' "home-regions" (N=23; right)

163 pants' "home-regions" are believed to be aesthetic, distinguishable/different from others, close to nature and quiet. As
 164 can be seen in the exemplary quotations of table 3, participants often highlighted certain aspects to underline the place
 165 character (in the exemplary quotations, e.g., the Baltic Sea, peasant structures, the river Wakenitz, and the former
 166 inner-German border). Table 4 presents all aspects found in the interviews structured along four main- and several
 167 sub-categories. However, participants did not agree in each and every aspect. A cross-case analysis also revealed
 168 inconsistent patterns of perception. While some highlighted the impressive canola blooming as characteristic for the
 169 region, others perceived it as typical for other regions and consequently as less important for their "home-region" (e.g.,
 170 I24). Likewise, fishery was seen by some respondents as a still preserved feature (e.g., I24), while others emphasized
 171 it as an already lost one (accompanied by feelings of grief; I16, I13).

172 3.2.2. Meaningful places in the Lahn study

173 In the Lahn study, participants marked 561 meaningful places within the study area, dominantly located near the
 174 Lahn river and concentrating in and near urban areas, as shown in Figure 3. Over half of the points (N=309; 55.1%)
 175 exhibit at least one descriptive meaning which were derived from the question "Why is this place meaningful to you?".

Meaningful places as an indicator for sense of place

Table 3
Main categories of participants "home-region" characterizations

Category	Exemplary quotation
Aesthetic	"That's very pretty there, too. Yes, there are quiet a lot corners, around and near Lübeck." (I2)
Distinguishable/different from others	"When I think of Lübeck, immediately I think of the Baltic Sea (...). This is decisive for me." (I9) "Everywhere in Mecklenburg [Mecklenburg is a German Federal State adjacent to Lübeck's eastern parts; F.K.] are only big structures due to the land consolidation. There are no more peasant structures. But this is something typical for Lübeck, what you can see here (...)." (I3)
Close to nature	"The [river; F.K.] Wakenitz was untouched for a long time, because there was the inner-German border. Here, we also speak of the 'Amazon of the north'. " (I23)
Quiet	"I love this quietness, which the nature emanates." (I19)

Table 4
Categorized core aspects of respondent's meaningful places

Category	Subcategory	Aspects
Landscape	Coastal landscape	Baltic Sea, Lübeck Bay (and its side bays), beaches, steep coasts, near-natural coastal areas, maritime climate
	Rivers and lakes	Various running waters and lakes, partly in a near-natural condition
	Topography and soils	Hilly topography, glacial character, outwash planes, dunes, sandy soils, partly extremely fertile soils
	Woods	High forest content, diverse forest areas, near-natural forest management
Land- and water-use	Small-scale features	Heath-lands, hedgerows
	Shipping and Fishery	Ferry traffic to Scandinavia, sailing vessels, fishery, historical ships
Settlement structures	Agriculture	High proportion of rape fields, mixture of small-scale (partly organic) and large-scale agriculture, mixture of arable, and grassland farming
	Rural settlement structures	Historic farmhouses (partly with thatched roofs), village character, peasant structures, manorhouses (mainly in the eastern parts)
	Historic city center	Brick-build historic houses, churches and other monuments of historical importance, UNESCO World Heritage
History	Coastal settlement structures	Seaside resorts, former fishing villages, harbours
	Lübeck as Hanseatic city	Hanseatic history and culture, European Hansemuseum
	Lübeck as border city	Former inner-German border in the immediate proximity

176 They were structured along 13 categories (Table 5 on page 12) based on Stephenson (2008). The most frequently
 177 revealed place meanings relate to practices carried out at that place, specifically activities, such as fishing or hiking.
 178 Relationship meanings (e.g. aesthetics and well-being) were mentioned relatively frequently as well. Forms, such as
 179 biotic features, rivers, and human settlements turned out as being less important. The strength of attachment varies

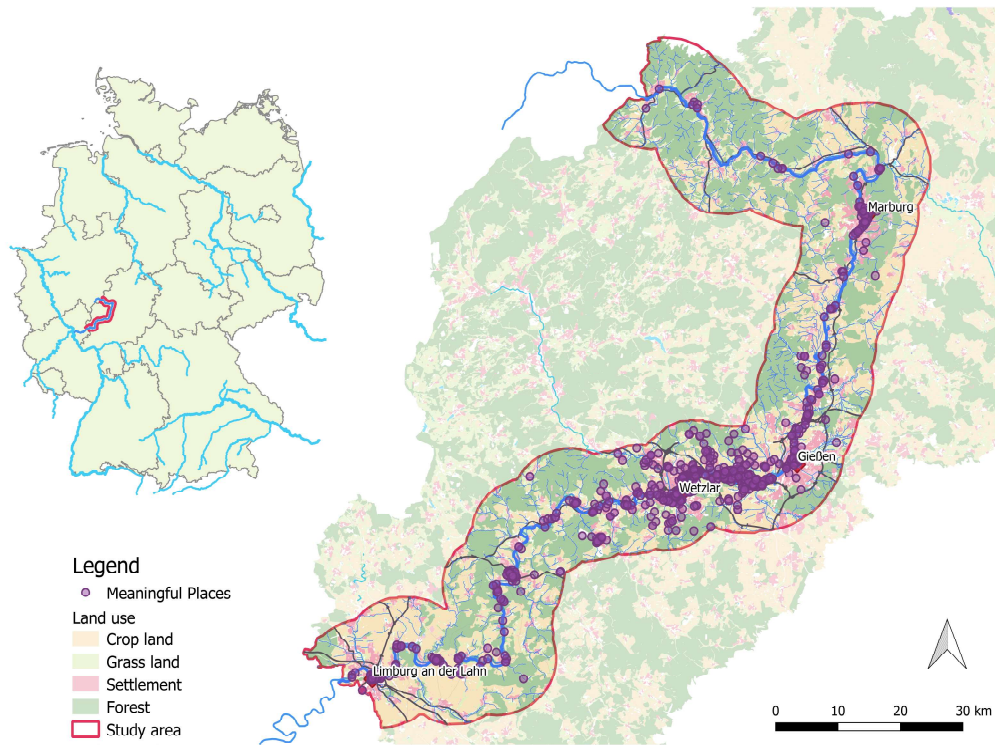


Figure 3: Location of the study area (top left) and distribution of meaningful paces in the Lahn-study (right)

180 between the meaning categories. Attachments could be measured for 444 meaningful places (mean=3.64, SD=.72;
 181 see table 5). Origin, home, everyday live and continuity yielded the strongest mean values, whereas activities, river
 182 and accessibility yielded the weakest attachment mean values.

183 Based on these data, it was possible to create visualizations for each category. Two maps are exemplary shown for
 184 the categories “biotic features” and “memories” (Figure 4), both exhibiting equally strong place attachments ($M=3.7$).
 185 Places meaningful due to memories, which respondents connect to them (e.g. to specific events or whole part of life)
 186 are rather located inside or close to urbanized areas. The western hotspot is located in the city center of Wetzlar, the
 187 eastern hotspot around the river meander surrounded by settlement and characterized by a variety of sport facilities.
 188 They show a stronger spatially clustered pattern than places that were located for their meanings related to biotic
 189 features, such as parks or specific animals. One of the hotspots is also located within the city center of Wetzlar, the
 190 most eastern hotspot is characterized by lakes and wetland. While these visualization assume an equal spatial extent of
 191 all places (points), respondents specified the actual extend of 30% of their meaningful places to be rather an elongated

Meaningful places as an indicator for sense of place

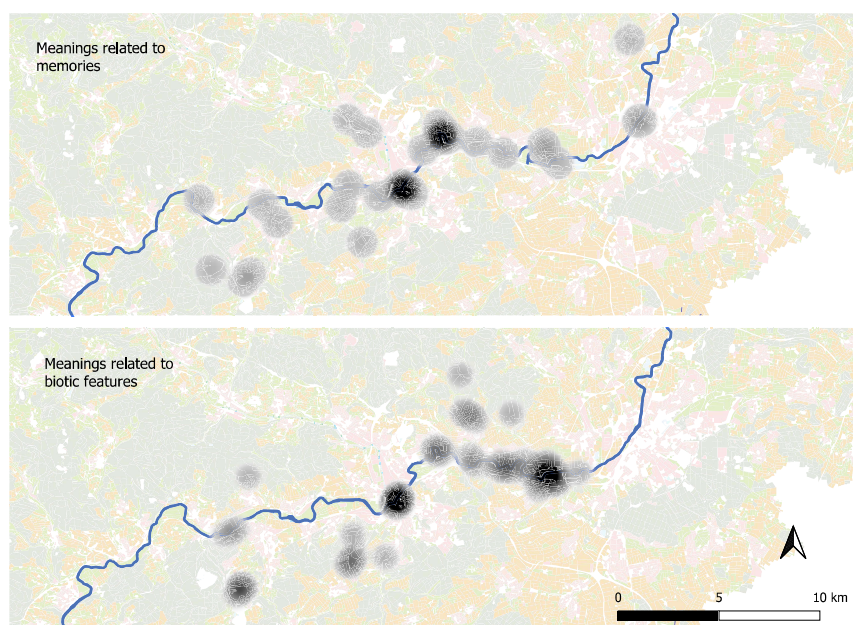


Figure 4: Heatmap of places meaningful due to “biotic features” and “memories”, radius=1000m

192 shape (e.g. stretch of the river), 19% a larger coherent area (e.g. part of a forest) and 19% and actual point (for 32% of
 193 the meaningful places the geometry was not specified by the respondent).

Table 5

Results of the question “Why is this place meaningful for you?”, note 1: frequency (number of points with attributed meanings category) and N (number of points with attributed meaning category and attachment response) are > 444, because several meaning categories could be attributed to one single meaningful place, note 2: “Heimat” and home refers to statements that express an identity or attachment to the place, in contrast the category origin encompasses statements about the place of birth or growing up without any specification for today's importance.

Categories	Frequency	Examples of codes	Attachment (M)	SD	N
Activities	102	Fishing, hiking, shopping	3.3	0.74	90
Aesthetics	79	Beauty, fantastic, cozy, neat, pristine, wide, idyllic	3.5	0.64	73
Well being	66	Happiness, quality of life, tranquility	3.5	0.68	60
Social	53	Club/association, friends, family, gastronomy	3.7	0.75	47
Biotic features (land)	53	Forest, parks, plants, animals	3.7	0.75	43
Everyday life	48	Centre of life, living, way to work	4	0.75	42
River	46	Lahn, floodplain, creek	3.2	0.74	41
Memories	44	Childhood, school	3.7	0.7	41
Human settlement structures	41	Castle, church, urban structures	3.5	0.69	40
Home and Heimat	25	'Heimat', home, my own	4	0.6	24
Continuity	20	Everyday, regularly	3.9	0.55	19
Accessibility	15	Accessible, central, close, proximity	3.4	0.51	13
Origin	12	Birth place, identity	4.2	0.51	13

194 **4. Discussion**

195 **4.1. Meaningful places: a spatially explicit indicator for sense of place**

196 This paper presented an indicator called “meaningful places” to spatially assess sense of place, a complex and not
197 directly measurable phenomenon in social-ecological systems. In line with presented benchmarks of environmental
198 indicators (see table 1 on page 3), the proposed indicator is both rooted in relevant strands of long-standing sense
199 of place scholarship and optimized for an intended purpose, which is the application in spatial planning processes.
200 The latter is achieved by the spatial explicitness of the indicator, i.e., its focus on spatial environments infused with
201 descriptive meanings and evaluative attachments. In two case studies, we found evidence for the indicators potential
202 to display meaningful places on maps and to enrich these data with further information. However, detailed insights
203 into the person-dimension (i.e. the extent to which meaningful places are driven by personal experience or the social
204 environment) or the process-dimension (i.e. the interplay of cognition, emotion, and behavior; Scannell and Gifford,
205 2010) remain out of the scope of this indicator.

206 **4.2. Transferability and measurability of meaningful places**

207 Our case studies demonstrated that analyzing sense of place through meaningful places is a transferable approach.
208 First (and as requested in section 1), it is applicable at different spatial scales. Meaningful places were assessed with
209 an emphasis on both regional (Lübeck-study) and local level places (Lahn-study). However, in the Lübeck-study, some
210 participants described rather local areas as their “home-region” and in the Lahn case, half of the respondents indicated
211 that their meaningful places extended over either an elongated course or a larger area. These results correspond to
212 previous research highlighting that place bonds are complex subjective constructs often not fitting with an a-priory
213 defined set of spatial scales (Charton-Vachet and Lombart, 2015; Knaps and Herrmann, 2018). Thus, planners should
214 be careful in determining (too) narrow and fixed scales of interest for the indicators application (e.g., by focusing only
215 on administrative entities at a specific spatial level). Second (and exceeding the benchmark of transferability in the
216 opening section), our indicator is transferable in the sense that it can be used in urban, sub-urban as well as in rural
217 areas. This is important to mention as the current emphasis of sense of place research is on the neighborhood and
218 community scale (Lewicka, 2010). Finally, the indicator is transferable to various planning contexts. Depending on
219 place specific planning requirements, it can be further narrowed to one specific aspect (as shown in the Lübeck-study

220 with the emphasis on place identity and the perceived character of participants' "home-regions") or used in an open
221 way to cover the whole range of meanings and attachments (as shown in the inclusive approach of the Lahn-study).

222 The depth and quality of the results, achieved in both case studies by employing contrasting methods, suggest
223 that meaningful places are straightforward to measure. Both case studies neither applied entirely novel methods nor
224 only standardized procedures. While quantitative surveys and the use of maps is well established in environmental
225 indication, the novelty of the Lahn case study is the combination of a mapping survey with established place attachment
226 scales and free listing exercises (to reveal the specific place meanings). Existing studies using PPGIS methods to
227 spatially assess sense of place do not cover the different dimensions and intensities of place attachment (Brown et al.,
228 2015), instead they focus on proxies for meanings (Brown et al., 2015; Pérez-Ramírez et al., 2019; García-Martín et al.,
229 2018). Our approach addresses these shortcomings by explicitly assessing the sense of place concept and uncovering
230 the different dimensions and sub-concepts. The results highlight the importance of combining descriptive meanings
231 with evaluative attachments by demonstrating how attachment intensity can vary across types of meanings. Qualitative
232 research methods (as used in the Lübeck-study) are still rarely used in environmental indication (for the prioritization of
233 quantitative approaches see Müller et al. 2012, for a rare example of qualitative designs see, e.g., Fagerholm et al. 2012).
234 Given the increasing relevance of holistic indicators, qualitative methods could be beneficial as they allow to deeply
235 tap into subjective values. In this regard, quantitative approaches are limited, as they use predefined belief-statements
236 derived from academic literature which do not necessarily correspond to participants' everyday life. Consequently, the
237 presented case study extends the methodical knowledge for the important field of qualitative indication in the realm of
238 social-ecological systems and at the same time offers an applicable approach to be used in practical planning. Yet, the
239 limitations of qualitative research (lack of generalization and the danger of bias through participant selection; Queirós
240 et al., 2017) require careful interpretations. Nevertheless, qualitative results can indicate strong tendencies especially
241 when participants with contrasting backgrounds (e.g., young, newcomer, laymen vs. old, native, stakeholder) exhibit
242 comparable patterns of interpretation.

243 If interest exists to gain more in-depth understandings of meaningful places as a foundation for spatial planning,
244 we recommend a tiered approach. It could start with a digital PPGIS survey incorporating a large and representative
245 sample of the local population. The analysis would elucidate spatial distributions or hot-spots of meaningful places
246 with detailed information on the intensity of attachments and types of meaning. In a second step, qualitative ap-

247 proaches could be employed around identified hot-spots to better understand the underlying diversity of perspectives
248 (including inconsistencies), and the most significant place characteristics. Such a tiered application could harness the
249 complementary strengths of different approaches presented in this article.

250 **4.3. Relevance of meaningful places in spatial planning**

251 Applications of our indicator produce sense of place-related data in a specific form. The emphasis on spatial
252 explicitness allows to integrate them into practical planning in various ways:

- 253 • They can help to *fill knowledge gaps* as they provide insights into the location and demarcations of meaningful
254 places as well as into the reasons, why and to which degree a location is perceived to be meaningful. Beyond
255 the intrinsic value of this information, a further potential lies in the fact that these data can be compared with
256 other spatially explicit data sets. Using geographic information systems, meaningful places could be digitally
257 analyzed with regard to the state of the underlying physical environment, foreseeable drivers of change (e.g., due
258 to new infrastructures or climate change adaptations) and their potential impacts. Precisely linking meaningful
259 places with recent, current and expected spatial developments allows for a better understanding of conflicts and
260 stakeholder behavior.
- 261 • Data about meaningful places and spatial analyses based on them can *prevent one-sided development* in two
262 ways. First, planners can determine new development priorities to sustain or even strengthen ascribed meanings
263 and respective attachments. This could include i) conservation and restoration of meaningful places or their
264 core features and functions, ii) plans for a more sophisticated multi-functional land-use, and especially in case
265 of conflicts iii) mediation at an early stage. The latter could obviate citizens' and stakeholders' disappointed
266 withdrawal which would make it impossible to integrate their further views and voices into decision-making.
267 Second, and in a more strategic way, planners could easily appraise if and inasmuch cross-border planning should
268 become an additional planning priority with regard to the management of meaningful places (in cases where they
269 exceed administrative borders).
- 270 • Data about meaningful places can contribute to *facilitate implementation* by their communicative power. The
271 latter refers to three data qualities: i) the closeness to citizens' everyday life (in opposition to other, rather abstract

272 planning topics such as species diversity), ii) the fact that the achieved results are co-produced by the participants
273 and iii) the tangibility of the result in the form of maps. Using the communicative power regularly in participation
274 processes gives evidence to stakeholders and residents that their perspectives are not only (implicitly) considered
275 but are explicitly taken into account. This can motivate to actively participate in planning processes and gives
276 an incentive to those who so far refused.

277 In this way, the outputs from meaningful place assessments can effectively be implemented in practical planning.
278 With the consideration of meaningful places, sense of place is integrated in planning and decision-making in a sufficient
279 manner. This broadens the perspective of planners, decision-makers, policy actors and stakeholders and thus supports
280 sustainable development approaches aiming at the harmonization of various land-use claims. Finally, sense of place
281 is often utilized as an indicator for other concepts e.g., community sustainability (Beckley et al., 2002), and social
282 sustainability (Proikaki et al., 2017). The accuracy, reliability and effective deployment of these indicators could also
283 benefit from precise sense of place assessments based on in-depth analysis of meaningful places.

284 **5. Conclusions**

285 The complex phenomenon called sense of place can contribute to sustainable spatial planning when it is easy
286 to assess and to integrate. This paper developed an indicator for sense of place which is i) conceptualized in line
287 with benchmarks of environmental indicators, ii) rooted in relevant strands long standing sense of place research and
288 iii) applicable spatial planning due to a spatial approach and a focus on graphic representations. In particular, our
289 suggestions for practical planning allow for overcoming the often indefinite approaches to integrate sense of place in
290 planning processes. However, developing environmental indicators is an extensive process. In line with the suggestions
291 from van Oudenhoven et al. (2018), further advancements should include:

- 292 ● Setting up expert panels with decision makers and practitioners to verify the indicators usefulness from a practical
293 point of view,
- 294 ● involving professional communication experts to enhance the indicators understandability,
- 295 ● developing more precise knowledge with regard to financial and time resources needed for assessing meaningful
296 places with varied methods.

- 297 • explore new assessment and analyses methods that take into account not only specific points but rather spatial
298 areas that people associate with meaningful places.

299 Further research about sense of place indicators should be devoted to these aspects.

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462 **A. Appendix**

Table 6

Number and characteristics of participants in the Lübeck case study (N=23)

Characteristic		Participants
Age	<30	4
	31-60	13
	>61	5
Gender	m	15
	f	7
Origin	Native	12
	Newcomer	11

Table 7

Number and characteristics of participants in the Lahn case study (N=244)

Characteristic		Participants
Age (N=237)	<20	0
	21-40	18
	41-60	137
	>61	82
Gender (N=241)	m	162
	f	79
Length of residency (N=244)	<10	9
	11-20	25
	21-30	30
	>30	178

Table 8

Guiding questions for the semi-structured interviews

Questions
Could you tell me something about your region?
Are there features which you consider as typical for your region?
Do you know features, of which people from another region would envy you?
What would you show a friend from Southern Germany on a one-day visit?
What would you miss from your region in times of absence?

Article II

Gottwald, S., Fagerholm, N., Albert C. (2021)

Combining sense of place theory with the ecosystem services concept – empirical insights and reflections from a participatory mapping study

In: Landscape Ecology

DOI: [10.1007/s10980-021-01362-z](https://doi.org/10.1007/s10980-021-01362-z)

Article III

Gottwald, S., Stedman, R.C. (2020)

Preserving ones meaningful place or not? Understanding environmental stewardship behaviour in river landscapes

In: Landscape and Urban Planning, 198, 103778

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Article IV

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merging mapping surveys and Geodesign workshops**

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