Ecosystem Services

Exploring perceptions of stakeholders' roles in ecosystem services co-production

--Manuscript Draft--

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Abstract:	Stakeholder engage in ecosystem services co-production as both co-producers and beneficiaries. Stakeholders' perceptions of their own and each other's roles in ecosystem services co-production therefore influences how ecosystem services are provided in a given landscape. However, only few studies shed light on these perceived and attributed stakeholder roles. The aim of this paper is to assess the self-perceived and attributed engagement and importance of stakeholders in the co-production of ecosystem services in a case study of the Lahn river landscape, Germany. The research questions address (i) local stakeholders' perceptions of their engagement in the co-production of ecosystem services, and (ii) differences and commonalities between self-perceived and attributed stakeholder importances in ecosystem services co-production. Our methods include a surveying local stakeholders regarding involvements in the co-production of twelve ecosystem services, and social network analysis assess survey data concerning network structures. Our findings indicate that self-perceived and attributed perceptions differ mainly regarding the central role of stakeholders in the collaboration networks.We further identify differences in perceived levels of importance of stakeholders within collaboration networks, but similarities in the understanding of their overal stakeholder network structure. We conclude by highlighting key implications for ecosystem services governance, among others the need to address power imbalances and to foster collaborative engagement for ensuring sustained and just ecosystem services delivery.
Suggested Reviewers:	Anke Fischer anke.fischer@hutton.ac.uk Published a paper presenting an analytical framework of ecosystem services co-production
	Antonia Eastwood antonia.eastwood@hutton.ac.uk Published a paper presenting an analytical framework of ecosystem services co-production
	Paul Opdam Paul.Opdam@wur.nl Published a paper about the importance of ecosystem services to connect different actors
Response to Reviewers:	

Dear Editor Prof. De Groot,

Thank you very much for your review of our manuscript, for the encouragement to write a revision, and for the helpful advice from the two reviewers.

As suggested, we have revised the manuscript according to the comments of the reviewers. Please find attached our revised manuscript and our response letter with detailed responses to all review comments. We followed the guidance of the reviewers to provide additional information in several places. In order to still keep the manuscript length within the limits, we revised the entire manuscript to make it even more concise.

We are confident that the revision has led to a further improvement of the manuscript quality. In case you have any questions, please do not hesitate to contact me.

Thank you very much!

Yours sincerely,

The authors

Camila Jericó-Daminello

Manuscript Number: ECOSER-D-19-00026

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Dear ...,

Thank you for submitting your manuscript to Ecosystem Services.

The evaluation of your manuscript is now completed and the handling editor recommends reconsideration of your manuscript following major revision. I therefore invite you to resubmit your manuscript after addressing the comments below.

...

When revising your manuscript, please consider all issues mentioned in the reviewers' comments carefully: please outline every change made in response to their comments and provide suitable rebuttals for any comments not addressed. Please note that your revised submission may need to be re-reviewed.

To submit your revised manuscript, please log in as an author at https://www.editorialmanager.com/ecoser/, and navigate to the "Submissions Needing Revision" folder.

We value your contribution and I look forward to receiving your revised manuscript.

With kind regards,

Rudolf de Groot
Editor-in-Chief
Ecosystem Services

Comments from the editors and reviewers:

Comments Associate Editor	
Please accept my personal apologies for the long delay in getting a decision on your manuscript. Getting two reviewers proved a difficult task. Between mid-January and early-September a total of 23 individuals were invited to be reviewers. After multiple reminder letters 10 responded by declining to do the review and 9 others were ultimately automatically “uninvited” due to non-response. In March and April, 4 agreed to review only to later withdraw or to be uninvited due to lack of	Dear Associate Editor, thank you for explaining the reason it took this long to get feedback on the paper. We appreciate your effort on this.

response. The first reviewer to complete a review accepted in early June and completed the review in late July. The final reviewer agreed in early September and completed the review in early October.	
In the end you do have two thorough and detailed reviews that exhibit considerable consensus on what revisions are needed. Both reviewers agree that the paper has the potential to make an important contribution to the research literature, but both also emphasize the need for more detailed presentation of the methods, analysis and results of the study. Both have made numerous very specific suggestions for what is needed to make the paper acceptable for publication. Please do address the revisions suggested and resubmit your paper. Only the two reviewers will be asked to respond to your revision and I will make every effort to get you a decision as soon as possible.	Thank you very much for your management of the review and comments on our manuscript. We have revised the manuscript as suggested, thereby carefully taking into account each of the comments made by the two reviewers. We provide detailed responses to each reviewer comment in the remainder of this table.
Reviewer #1	
abstract language clumsy	Thank you for flagging this. We have revised the abstract carefully and polished the language.
why is it important to study the difference between perceived importance and attributed importance? It would be useful to read about why this particular study was conducted?	Thank you for your questions. We are confident that this information is of major importance for the following reasons, and we have added the following text in the manuscript: "Analyses of perceived and attributed importances of stakeholders' roles in ecosystem services co-production, as well as of potential differences, may provide useful insights regarding relationships in actor networks engaged in ecosystem services management. While information on perceived importances reveals how actors see their own responsibilities, information on attributed importances illustrates perceptions from others (Fischer and Eastwood, 2016; Gissi and Garramone, 2018). Understanding the differences can help explain inadequate ecosystem services management where some actors are not aware of or do not want to assume the responsibility of ecosystem services management that other actors attribute to them. Vice versa, some actors might assign responsibilities to others who, in effect, do not have the capacities and intention to fulfill this role (Opdam et al., 2015; Loft et al., 2015). Taking this information into account can help planning, management, and governance of ecosystem services (Mann et al., 2015; Sattler et al., 2018)." (Lines 151-162).
SPECIFIC COMMENTS: 1.1 when describing the state of the river, it would be	Thank you for your comment. Indeed, a better understanding of the river ecosystem services

useful to connect the description to the state of the ecosystem services - this would help to connect the results to the broader concern about conservation status of the river	conservation status and management would be a very interesting route. For this specific manuscript, we won't bring in-depth discussions about it because we don´t have this specific information about the ecosystem services. To acknowledge the relevance of the topic you brought, we added the following sentence: “A promising field for future research is also to explore relations between perceived and attributed importance on the one hand, and the actual management of ecosystem services, or their conservation status, on the other hand.”(Lines 622-624). Unfortunately, no information is so far available on the status and trends of ecosystem services provision of the river, but several assumptions can be made based on the knowledge of the state of the river ecosystem. We have therefore added the following: “Up to now, no information on the status and trends of ecosystem services provision and demand has been published for the Lahn river. However, the generally poor ecosystem quality of the Lahn river according to the EU water framework directive suggests that the transformation of the river and its floodplain may have resulted in positive impacts for some ecosystem services (such as agriculture in the former floodplain area) but also negative impacts on several other, primarily regulation ecosystem services (such as water retention, nitrogen retention, carbon storage)”. (Lines 616-622).
1.1 the 8 groups identified with "shared common interests" were identified by whom in what way? Do we know whether these groups recognize themselves and if so, what connects them besides common activities? (group self-recognition is not a necessity, but this is an important question since the groups are used in the survey and individual respondents seem to be required to be identified with one of them)	Thank you for this hint that we did not further explain how the interest groups were defined. As this research took place in a transdisciplinary research project, we collaborated with some practice partners (another, practice-oriented project called LiLa Project) who work on the development concept for the river and who were responsible for local stakeholder communication. They conducted so-called interest workshops with the local public in three different places along the river where people exchanged their interests regarding the development of the river landscape. As a result of these workshops the stakeholders built thematic working groups who then periodically met to develop a paper on the key goals of their group. Stakeholders could freely decide which working group they wanted to participate in. For our research we built upon this work and adopted the eight thematic working groups and

	conducted the survey amongst all participants of the working groups. To be more clear in the manuscript we adapted the text as follows: “As a result of these workshops the stakeholders built eight thematic working groups who then periodically met to develop a paper on the key goals of their group. Eight groups of local stakeholders were identified which shared common interests related to the same topics. Those eight stakeholder groups were formed around the topics of 'Nature and Ecology', 'Recreational Motor Boating', 'Rowing and Canoeing', 'Agriculture, Forestry and Hunting', 'Water Management', 'Tourism and Local Recreation', 'Municipal Development and Land Planning' and 'Recreational Angling'. Stakeholders could freely decide which working group they wanted to participate in. In the herein reported research, we apply the same stakeholder groups”. (Lines 203-211).
2.1 how was the sample created to whom the survey was sent? what is the base population? Please be much more quantitative here.	Thank you for the critical remark. The full sample consisted of the 98 stakeholders who had previously associated themselves with one of the eight thematic working groups in the LiLa project as described above. Participants could represent certain governmental or non-organizations or being interested citizens that wanted to participate in the process. The results therefore are limited to the identified interest groups which at this point participated in the development of the river management concept. We adapted the text in the manuscript as follows: “In July 2018, the online survey was sent to altogether 98 representatives of the above mentioned eight stakeholders’ groups as established by LiLa”. (Lines 251-252). Further, we included the limitation of the sample in the discussion section: “The results further limited to the identified interest groups which at this point participated in the development of the river management concept.” (Lines 609-611).
2.1 the groups generated by the authors and the additional groups identified by the respondents are rather hard to interpret. It is not clear how they were defined, they are not all clearly connected to ecosystem services (but some of them are), sometimes it is likely, that memberships overlap, but this is not mentioned nor is it reflected upon in the methods - so what do these groups represent after all?	Thank you for noticing. As we describe above, respondents stem from the full sample of stakeholders who had previously associated themselves with one of those thematic groups. It was our purpose to survey stakeholders as they had associated themselves and not necessarily stakeholders strictly related to some ecosystem services because we wanted to explore relationships between stakeholders to multiple ecosystem services, and vice-versa. Individual group memberships do not overlap as members had

	previously associated themselves with only one such group. The connection of interest groups to ecosystem services was done by themselves as they were asked in the survey from which ecosystem services they benefit and which of them they provide.
* paragraph 2.2 is missing from the manuscript	Thank you for noting. It was a simple mistake of numbering the sections wrongly. We now corrected accordingly.
2.3 the survey contained 34 questions but none of them is cited. It is not clear for the reader what kind of questions were asked. From the 4 question categories and the description in this paragraph it seems that respondents had to answer questions related to "ecosystem services" and maybe other scientific terms, that may not have a clear definition for non-expert respondents. It is also a question how "collaboration" was formulated in the survey. This question (together with the definition of the groups) essentially generates the network data that is analysed later on, so clarity on these two points should be improved. Without these, it is very hard to judge the quality of the analysis. It is also not clear whether respondents had to identify with one of the groups and how overlaps between groups were treated in the survey? How was it treated if members of the same group described different relationships to others?	Thank you for raising these questions and concerns. The whole survey can be found in the supplementary material. Indeed, there was special attention to not apply specific scientific terms in the survey, but to use explanations instead that would be closer to interviewees reality. Please, note the whole survey was conducted in German and the version presented here is translated to English. The whole section '2. Methods' was restructured in accordance with many of the comments from both reviewers. We hope your questions are now clarified in the text. The group memberships do not overlap as people decide which group they want to belong to. Every time one respondent identified a link of collaboration with another actor, a link was added between the two stakeholder groups to which the respondent and the partner respectively belonged. So, if different relationships were identified by different stakeholders of the same groups, all these relations were included. The links of one group is a result of the sum of all links of its group members.
2.4.3 It is not defined in this paper what "importance" means for stakeholders. I do not see how importance can be connected to indegree or outdegree. For instance indegree could be interpreted as power, influence, trust, outdegree could be interpreted as communication or PR activity, lobby, or some kind of management work. It does happen that important players do not have a high outdegree since they do not need many connections and collaborators to be taken into account. Anyway, "important" has to be defined. I recommend using different interpretations for indegree and outdegree. As much as the survey structure can be reconstructed based on the manuscript, I also recommend using weighted edges - this would help interpret how much various group	Thank you for signaling that the method section was not quite understandable. We restructured the whole section and hope the understanding improved. We present the definition of importance right at the beginning of the methodological approach (section 2.2 Methodological approach: Social Network Analysis (SNA)), as well as our interpretation of indegree and outdegree centrality. One misunderstanding is also that we do not analyze communication networks but only the collaboration network for each co-produced ecosystem service. The respective survey question reads: "Do you cooperate with other actor groups

members agreed with each other on the existence of the connections.	for certain services to preserve the Lahn landscape?” We also present a justification why we did not use weight edges as we wanted to avoid underestimating potential existing links that were not mentioned by a group with a reduced number of respondents. You find our justification on section 2.4 Data analysis.
3. my comments to 2.4.3 apply here very much too. Indegree and outdegree are different, this is not a very surprising result. Definition of "importance" is still lacking, but a more detailed description of the survey would be helpful to see what kind of legitimate interpreations are possible here. Indegree and outdegree in this network should be similar, if "collaboration" would be defined clearly (meaning: in the survey it is clear to all respondents what is being asked) thus it could be expected that both ends of the edge recognizes some activity as "collaboration". Since in this dataset in- and outdegree are not the same, this network data seems to represent a social communication network, where power, trust, outreach, lobby and other activities are somehow mixed (again, depending on what questions were actually asked).	Thank you for flagging your concerns. Please see our detailed response above which in our view clarifies the matter.
* In the descriptions, stakeholders and groups are not clearly distinguished. For the reader it is hard to decide whether expressions like "participate" or "self-percieved" refer to groups or individuals. While the method section would suggest groups, it is hard to imagine how a group can "perceive itself". This is confusing.	Thank you for your question. The data collection was all based on questions focusing on the individuals. We clarify this explicitly in the methods section 2.3 Data collection - online survey. In addition, we also follow your suggestion to include the translated questionnaire as supplementary information which should further clarify our approach. While we assessed responses individually, we then merged the responses of those individuals that perceived themselves as belonging to the same 'stakeholder group'. By that, we have inferred that the different answers from individuals of the same group could be understood as answers of that group. In other words, answers from individuals of the same group accounted for answers of that whole group. We are confident that this approach provides insights into the diversity of perceptions embodied within each stakeholder group, while acknowledging that we do not provide information on how many individuals reflected referred to a particular relationship. We added a sentence about it: "Each respondent was asked to identify him/herself as being part of

	one stakeholder group. Consequently, the group answers represent the merged responses provided by the respondents included in that specific group." (Lines 312-314).
* As the reader progresses, a clear definition of "importance" is more and more lacking. Re-interpretation of the network edges in this dataset is recommended.	Thank you! See clarification provided above and the definition of importance and our understanding of network edges in section 2.2 Methodological approach: Social Network Analysis (SNA).
4. I wonder why the authors assume that an actors self-perceived importance should ideally match the attributed importance? ("underestimated" and "overestimated" importance) Many people do very important conservation work in various landscapes that is not recognized by their peers, yet without them huge values would disappear. Maybe some of these people does recognize the crucial importance of their mission.	Thank you for the critical remark. In fact, we do not assume that an actor's self-perceived importance necessarily or ideally needs to match attributed importance. In contrast, we simply suggest that information about self-perceived or attributed levels of importance can help explain mis-management or too little stewardship of ecosystem services, resulting in sub-optimal provision and potentially deficits. The information we generate can thus provide insights into this, and help develop better governance models that either provide relevant information, e.g. to inform stakeholders of what responsibilities they have given their mandate or existing regulations, or to provide incentives for stakeholders who so far do not assume full responsibility. We now include this argument in the discussion section where we write: "This information can in a first step help to explain mis-management or too little stewardship of ecosystem services, resulting in sub-optimal provision and potentially deficits. And in a second step, it can help to develop better governance models that either provide relevant information, e.g. to inform stakeholders of what responsibilities they have given their mandate or existing regulations, or to provide incentives for stakeholders who so far do not assume full responsibility." (Lines 546-551).
* In summary: the authors should be much more transparent in their methodologies and in how theories are linked to the applied methods. Also, multiple important concepts applied in this manuscript should be defined much more clearly.	Thank you very much for the insightful review and the comments for further improvement.
* The applied survey might be added as supplementary information.	Thank you for your suggestion. The entire survey and extra information sent to the interviewees are now added as supplementary information (A. Appendices, A.1 Survey).
Reviewer #2	

The manuscript "Exploring perceptions of stakeholders' roles in ecosystem services co-production" addresses an important and innovative topic, however the wider applications of the obtained results and the potential of this approach replication to other ecosystems and contexts could be more explored. It is a very interesting idea, however the choice of the methods should be better detailed and it seems that there was room for more responses which would benefit the outcomes. Some suggestions are made in order to improve the presentation and understanding of the work. Overall the manuscript is well structured pointing out the main issues to be addressed in the context of this research.	Thank you very much for the kind words. We appreciate the value you see in our study. The wider application of the obtained results and a potential replication to other case studies would be indeed very interesting. So we are carefully taking into account each of the comments in the revised version of the manuscript. We understand the need for more clarification of the methodology. In this new version, we are bringing more detailed information in the text body, and we add the full version of the survey in the supplementary information..
Introduction: The introduction is well written, highlighting the main topics under discussion. However, it would benefit the paper if the authors include here more works were the methods applied in this research were already used, for example Social Network Analysis for stakeholders perceptions on their dependency on Ecosystem Services (Lopes and Videira, 2016).	Thank you for this comment and for pointing out the relevance of this reference. We have included this interesting work in two different places of our manuscript, introduction and conclusion. In introduction, we brought it as one example of using SNA on perceptions from stakeholders in relation to ecosystem services (Lines 116-119). In conclusion, together with another, to highlight the relevance of this new field and our contribution to it while respecting the word limit (Lines 500-501).
The presentation of the case study seems more suitable for the beginning of the methodology or creating a different section. Having just a sub-section here (1.1) doesn´t seems work well. Additionally, it would be interesting to have a map of the case study, explaining better the area under study.	Thank you for your suggestion. We have decided to create a new section for the case study. Since some of the comments are about restructuring the Methods section, we felt it would be clearer to have the case study separately. A map of the Lahn river is included at the end of the section: 2.1 Case study description: the Lahn river landscape.
Methods: Subsections are not well defined (2.2. is missing).	Thank you for noting. It was a simple mistake of numbering the sections wrongly. It is already corrected.
This section could be better presented. It should be more detailed and justified. The authors should have in mind the possibility of replication when describing the process, and because of this providing more details. For example how were the stakeholders mapped? What was the methodology used?	Thank you! We followed your advice and restructured the methods section. We hope that it becomes clear now that the stakeholders are mapped and grouped by themselves in the course of the LiLa project.
Table 1 - The selection of stakeholder groups is not very clear. How they were defined? Based on what criteria? The stakeholder groups defined in this study are not at the same level. For example "private business" and "recreational Motor Boating" could have the same stakeholders, the same for "nature and ecology" and "local clubs and associations". Why the authors did not organize the stakeholders groups by - private business; NGO; Public organizations, etc.	Thank you for this hint! Please see response to reviewer 1 above who criticized the same. For our research we built upon the work of the LiLa project and adopted the eight thematic working groups they developed together with the stakeholder and conducted the survey amongst all participants of the working groups.

and within this categories differentiate by topic (agriculture; nature and ecology; etc.)? Did the authors considered to send the survey to these additional six stakeholder groups? It is strange to consider them as a group and not having information collected from them. Regarding this table, the authors should provide more information and clarification on the choices that were made, having in mind they these choices could have impacts on the obtained outcomes and their reading.	To be more clear in the manuscript we adapted the text as follows: “As a result of these workshops the stakeholders built eight thematic working groups who then periodically met to develop a paper on the key goals of their group. Eight groups of local stakeholders were identified which shared common interests related to the same topics. Those eight stakeholder groups were formed around the topics of 'Nature and Ecology', 'Recreational Motor Boating', 'Rowing and Canoeing', 'Agriculture, Forestry and Hunting', 'Water Management', 'Tourism and Local Recreation', 'Municipal Development and Land Planning' and 'Recreational Angling'. Stakeholders could freely decide which working group they wanted to participate in.” (Lines 203-210). The six additional groups turned out as the question on which group the interviewees collaborated with contained others that were not mentioned in the survey. These extra groups were constructed based on the answers. To make the choices more clear we separated the eight original stakeholder groups from the six extra groups. The original ones are mentioned in section 2.3 Data collection - online survey and listed in Table 1. The six extra stakeholder groups are explained in section ‘3. Results’ and listed in Table 2. The survey has not been sent to the extra groups as we did not know the exact individuals that belong to them and we had limited our sample size to the stakeholders participating in the LiLa working groups.
Why did the authors follow the TEEB classification? There are a relatively recent common understanding on the use of CICES framework (despite some problems that could also be identified), and on the other hand MEA (2005) is a wider used alternative in the literature. By using TEEB classification are the authors showing a bias into economic valuation? Please provide a clarification on that. More information on the survey and on the questions should be provided. How was the duration, in average, to answer the survey? A suggestion is to present a table with the questions grouped in the four categories. Besides this, more information on the survey participants should be presented. Were they aware of the concept of "ecosystem services" and the term co-production?	Thank you for raising these questions. In relation to the TEEB classification, there are no expectations to connect this paper with ecosystem services economic valuation. The reason we mentioned the TEEB classification is that it was the basis for the RESI-Project (www.resi-project.info). We build our ecosystem services classification on the prior work of the RESI-Project which had proved as a useful and relevant classification for river ecosystem services. To make it more clear we had added the sentence "The selection of the ecosystem services included in the study was based on a list of ecosystem services for German river landscapes (Podschun et al. 2018), which in turn was inspired by the practically relevant TEEB project (2010). In addition, consultation with local actors was applied to adapt the list from Podschun et al. (2018) to the very

	specific context conditions of the Lahn river landscape and to suit it to stakeholder understandings" (Lines 269-273). In relation to the survey itself, the whole survey can be found in the supplementary material. Due to the word limit unfortunately we have decided to maintain the questions only in the supplementary material. More information on the survey itself has been added in the following sentence "Data collection took place during May - June/2018. An invitation was sent via e-mail to all potential respondents. The survey was open for almost four weeks and, in the meantime, a reminder e-mail was sent". (Lines 297-299"). Indeed, there was special attention to not bring specific scientific terms, but instead, explanations that would be closer to interviewees reality. Please, note the whole survey was conducted in German and the version presented here is translated to English.
Why the authors selected on-line surveys to conduct this study instead of interviews? Some thoughts on the methods choices and their advantages and limitations should be provided.	Thank you for your question. While we agree that interviews would have allowed for some more in-depth analyses, we content that the survey method is better suited to collect data from a high number of respondents as in our case. As we outline above, our full sample was already quite big with 98 individuals. Conducting interviews with such a high number of people would not have been feasible within the scope of this research.
Results: This section should be divided in sub-sections for a better understanding. For example by the main groups of results, or the main messages (the ones from the discussion section).	Thank you for your suggestion. We have divided section 3. Results into three subsections as follows: 3.1 Relative importance and centrality of stakeholders in ecosystem services co-production, 3.2 Differences between perceived and attributed stakeholder roles 3.3 Stakeholders´ net importance in ecosystem services co-production. This line of thought is also reflected in the line of paragraphs in section 4. Discussion and conclusions.
Figure 2 seems more like a table.	Thank you for the suggestion. We have converted the figure into a table. Since there is a limitation on the number of characters to be used in a table title, we have now simplified the title and included the rest of the relevant information below the table body as notes.
The fact that the additional six stakeholder groups were not questioned poses a bias on the results. For example Figure 3 could have a misleading reading.	Thank you for bringing this up. In fact, a second survey was not conducted, which could be an opportunity to hear from these additional six stakeholder groups. However, it is noted the relevance of ask about groups we haven´t mapped before, otherwise we would lose important data

	about these groups. That is the reason why we have decided to keep them on our analysis even if only in the “networks in the attributed participation”.
Figure 4 is a very interesting way to communicate, however it could be a bit confusing, so a suggestion is to integrate the information that is on the legend in the text body as an introduction to the figure.	Thank you for the kind words and your suggestion. We have incorporated the information in the text body. Please note, because of one of the reviewers´ comments the figures' numbers have changed.
In Figure 5 the authors only consider 8 groups of stakeholders, It would be better to have a coherence in terms of what stakeholder groups to consider throughout the results presentation. It would be interesting to have a reading of this figure by column, understanding the implications of these results for the management of this ecosystem services. For example, are the services perceived as having less contribution to co-production the ones that are more threatened or less preserved in this area?	Thank you for bringing this interesting discussion. For Figure 4, the stakeholder importance was calculated by the difference between perceived and attributed importance. This means that only the groups that had perceived importance (i.e. that had respondents on the survey) were included. To avoid any potential misunderstandings, we have changed the term "stakeholder importance" to "stakeholder net importance". The "stakeholder net importance" is calculated by the difference (P-A) between the perceived (P) and attributed (A) importance. Concerning connecting the results of Figure 4 with the management of the ecosystem services, we agree with your comment and see this being one of the promising next steps of this study. For this specific manuscript, we will not bring in-depth discussion because we do not have the information on the ecosystem services preservation or conservation status. Against this background we added the sentence "A promising field for future research is also to explore relations between perceived and attributed importance on the one hand, and the actual management of ecosystem services, or their conservation status, on the other hand." (Lines 622-624).
In this study Ecosystem Services are analyzed in an isolated way. Since ecosystem services are interlinked and their provision and sustainable flow are dependent on each other (Lopes and Videira, 2017), is it possible that this approach loses information on the co-production process?	Thank you for this contribution. We certainly agree with the reviewer that ES are interlinked and interdependent. The article however focuses on actors’ perceptions and therefore does not inform on the existing interdependencies. We have acknowledged this as part of the limitations of the study and called for future research to look into it. In the Introduction section we have included this study as one example of connection perception with ecosystem services, from the optic of interdependence (Lines 118-119). And in the Discussion and Conclusion section, we have included the following sentence: .”An interesting avenue for future research would be to investigate whether actors’ perceptions of involvement also reveal existing ES interdependencies.” (Lines 615-617).
Discussion and Conclusion: Line 51 page 18 it is not clear the affirmation "our	Thank you for your question. With this affirmation, we wanted to highlight the relevance of our study

stakeholder analysis for co-production of ecosystem services is generating knowledge and providing information about the linkages between ecosystem services and their provision". Please provide explanation on that.	on contributing to building knowledge on the linkages between ecosystem services and how they are provided. Specifically, the linkage between ecosystem services and the stakeholders responsible for their provision. In an attempt to make our affirmation clearer, the new sentence reads: "Finally, our study contributes in generating knowledge and providing information about the linkages between ecosystem services and how they are provided, more specifically, who is co-responsible for their provision." (Lines 557-559)
The authors have choose to present the results and the discussion in different sections. Despite this could work, I think that in this case the results could have helped to draw some lessons and discuss the implications more deeply. Having said this, these two sections could remain like this, however discussion section should be better framed. Organizing the discussion by lessons learned or main messages could help to provide this frame.	Thank you for your suggestion. We have divided section 3.Results into three subsections as follows: 3.1 Relative importance and centrality of stakeholders in ecosystem services co-production, 3.2 Differences between perceived and attributed stakeholder roles 3.3 Stakeholders´ net importance in ecosystem services co-production. This train of thought is also reflected in section 4. Discussion and conclusion, even if not being divided in sub-sections. In addition, we have refrained from merging results and discussions as this might confuse readers. We are confident that the better organisation of the results and discussion make the reading more clear and enjoyable.
References: * Lopes, R. and Videira, N. 2017. Modelling feedback processes underpinning management of ecosystem services: The role of participatory systems mapping. Ecosystem Services, 28: 28-42. * Lopes, R. and Videira, N. 2016. A collaborative approach for scoping ecosystem services with stakeholders: The case of Arrábida Natural Park. Environmental Management, 58 (2):323-342.	Thank you. We read the suggested references and found them very useful. We have now included them as citations and references in the manuscript.

Highlights

- Stakeholders' perceived roles in ecosystem services co-production rarely studied
- Perceived and attributed roles investigated via social network analysis
- Lahn landscape case study shows differences in perception of central role
- However, perceived network structure very similar across stakeholders

Declaration of interests

☒The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Highlights

- Stakeholder~~²~~s' perceived roles in ecosystem services co-production rarely studied
- Perceived and attributed roles investigated via social network analysis
- Lahn landscape case study shows differences in perception of central role
- However, perceived network structure very similar across stakeholders

Abstract

~~Stakeholders can assume dual roles~~ Stakeholder engage in ecosystem services co-production ~~of~~ ~~In ecosystem services can~~ co-production ~~assign stakeholders with can assume two roles: as~~ as both co-producers and beneficiaries ~~and producers~~. Stakeholders' perceptions~~SHow stakeholders perceptions~~ of ~~perceive~~ their own and each other's ~~own~~ role~~s~~ ~~in co-production, and the role of others~~ in ecosystem services co-production ~~this process~~ therefore ~~may thus~~ influences ~~play an important issue in~~ how ecosystem services are ~~delivered and~~ provided in a given landscape. However, only few studies~~very little research scholarship is hitherto available that~~ shed~~s~~ light on th~~ese~~~~ese~~ perceived and attributed stakeholder roles. The aim of this paper is to assess the self-perceived and attributed engagement and importance of stakeholders in the co-production of ecosystem services in a case study of the Lahn river landscape, Germany. The research questions address ~~concern~~ (i) ~~how~~ local stakeholders' perceptions~~perceive~~ of their ~~own~~ engagement in the co-production of ecosystem services, and (ii) ~~which~~ differences and commonalities ~~exist~~ between self-perceived and attributed stakeholder importance~~s~~ in ecosystem services co-production.

Our methods include ~~First, we applied~~ a surveying ~~of to~~ local stakeholders regarding involvements in ~~asking about their own involvement and the involvement of others on collaboration networks for~~ the co-production of twelve ecosystem services, and ~~. Second, we used~~ social network analysis assess survey data concerning ~~to construct the~~ network structures~~s and understand some differences between opposite perspectives~~. Our findings indicate that self-perceived and attributed perceptions differ mainly regarding the central role of stakeholders in~~on~~ the collaboration networks., ~~while the network ir structures are very similar.~~ We further identify differences in perceived ~~perceptions of the~~ levels of importance of ~~various~~ stakeholders within ~~the~~ collaboration networks, but similarities in the understanding of their overal ~~in the~~ stakeholder network structure ~~of who is involved and how they are connected~~. We conclude by ~~with a reflection on key~~ highlighting key implications for ecosystem services governance, among others the need to ~~including the issue of how to~~ address power imbalances and to foster collaborative engagement for ensuring sustained and just ecosystem services delivery.

Keywords
Ecosystem services co-production; Collaboration; Social network analysis; Stakeholders' perspectives; Lahn river landscape

1. Introduction

The flow of ecosystem services to people often does not function independently but requires substantial human contributions (Diaz et al., 2018; Albert et al., 2016; Burkhard et al., 2014; UK NEA, 2011). Those human contributions are also termed “other inputs” (Burkhard et al., 2014), "human inputs" (Albert et al., 2016; von Haaren et al., 2014), "social and human capital" (Daniel et al., 2012), "complex social processes" (Spangenberg et al., 2014b), or "human activity" (which leads the authors to propose the "social-ecological services" denomination) (Huntsinger and Oviedo, 2014). Ecosystem services are thus co-produced through natural and anthropogenic contributions (Gissi and Garramone, 2018; Raymond et al., 2017; Berbés-Blázquez et al., 2016; Fischer and Eastwood, 2016; Palomo et al., 2016). When it comes to provisioning ecosystem services, the need for human intervention in the process is relatively obvious. For example, water needs to be pumped, cleaned, and delivered to human settlements to serve as drinking water; or food needs to be harvested, hunted, or produced by the various kinds of agricultural practices (von Haaren et al., 2014). In regulating ecosystem services, human contributions tend to be indirect.~~,~~ A~~a~~n example is the need for targeted management of urban green spaces in ways that maximize local climate regulation and air purification (Scholz et al., 2018). Finally, cultural ecosystem services require human interventions as well, namely to preserve specific cultural landscape characters or to provide information and infrastructure that enables and enhances humans’ aesthetic appreciation of landscapes (Hudson, 2001). It is known and well documented that people are important in co-producing ecosystem services. From this starting point, we argue the

importance of studying how people perceive their own role in this production as well as how they perceive the role of others.

The starting point of humans' involvement with ecosystem services is the possibility of assuming two different roles (Fig.1). On the one hand, stakeholders can be active in co-producing ecosystem services (Rova and Pravoni, 2017; Loft et al., 2015, Opdam et al., 2015). For example, farmers manage their soils to grow food and energy crops, landscape stewards develop green and blue infrastructure for natural pest control and the regulation of extreme weather events, and regional managers engage in the education of citizens and visitors in the context of nature-based recreation (Andersson et al., 2019; Loos et al., 2019; Keestra et al., 2018; Weijerman et al., 2017). On the other hand, stakeholders and citizens also benefit from the delivery of (often co-produced) ecosystem services, such as enjoying local dishes, safeguarding against flood risks, or appreciating beautiful landscapes (Dou et al., 2017; Kaltenborn et al., 2017).

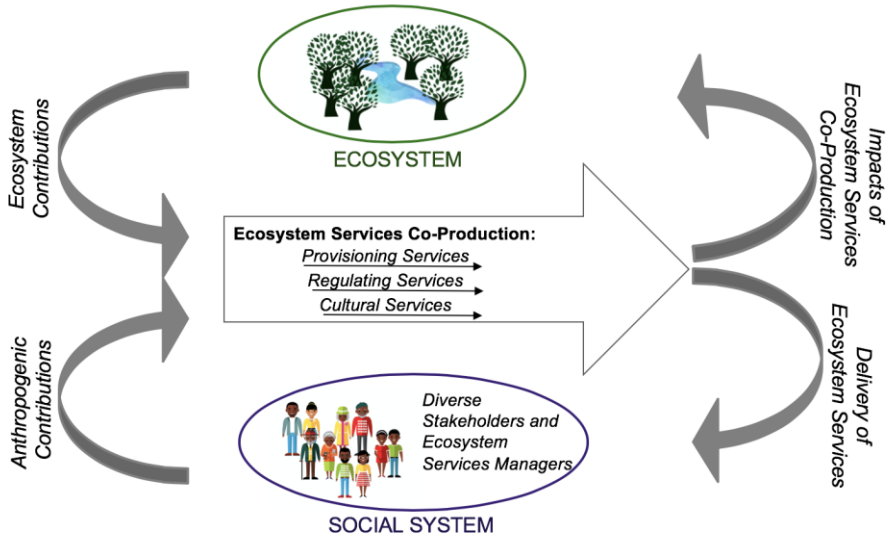

Figure 1: Ecosystem services are produced through ecosystem contributions combined with anthropogenic contributions. The former happens in the ecosystem through a diverse set of processes and functions, while the latter happens in the social system through the action of different stakeholders which can include ecosystem services management. Ecosystem services co-production is observed in provisioning services, regulating services, and cultural services. The co-production processes have impacts on ~~the~~ ecosystems and benefit~~s~~ the social system. Thus, people can assume a dual role in ecosystem services co-production - as active contributors to co-production, and as beneficiaries from ecosystem services delivery.

A stakeholder's dual role is not only when they act as beneficiaries *vs* co-producers, as described before, but it can also be observed when taking a ~~when we look~~ closer look at the co-provider role.

The co-provider role can be observed as ~~as:~~ how people perceive~~d~~ themselves being co-providers of ecosystem services *vs* how others perceive~~d~~ them in that same role.~~?~~ Research on the dual role of stakeholders in ecosystem services co-production has only recently emerged. For instance, Bérbes-Bláquez et al., (2016) explored how power relations influence the delivery of ecosystem services ~~delivery~~; Palomo et al., (2016) assessed the effect of co-production on ecosystem services trade-offs, resilience, distributional equity, among other characteristics; Rival and Muradian (2013) observed the behavior of co-producers ~~behaviors~~ especially in transactional processes like payment for ecosystem services; Fortnam et al. (2019) debated the influence of cultural norms on gender relation in ecosystem services co-production; Ernstson (2013) discussed the role of social and political processes on environmental justice related to the delivery of ecosystem services; ~~and~~ Opdam et al. (2015) argued the importance of ecosystem services in connecting actors in landscape planning, suggesting the significance of actor's' contextual aspects and the need for~~of~~ further investigation on substantial coordination among co-producers; and Lopes and Videira demonstrated~~,~~ in one study (2016) the~~,~~ perceived dependencies of stakeholder groups on different ecosystem services, while in another study (2017), they shed a light on the linkage between ecosystem services interdependencies and perceptions of stakeholders´ involvement.~~.~~ However, in-depth investigations of how people themselves perceive their roles, or how their roles are perceived by others, have so far been largely missing. An exception is the work of~~by~~ Fisher and Eastwood (2016) who, in reflecting the relations between people and ecosystems, recognize the importance of identity (including perceptions of themselves) which would shape how people engage and understand ecosystem services. The studies and frameworks developed so far mak~~d~~e good progress i~~o~~n enlightening co-production of ecosystem services and the existence and importance of the people involved. Yet, those studies do not discuss people's own perspectives and relevance of this approach. New research is necessary in order to start understanding what such involvement entails and how it can be influential on the thematic of ecosystem services.~~In order to start understanding what such involvement entails and how it can be influential on ecosystem services thematic, new research is necessary.~~ This article seeks to contribute to such an endeavor.

River landscapes arguably provide very suitable context conditions to study the dual role of stakeholders in ecosystem services co-production. River landscapes are hotspots for the delivery of ecosystem services ~~delivery~~, and at the same time are areas where diverse demands for the delivery of ecosystem services ~~delivery~~ exist.~~,~~ F~~f~~or example, the mitigation of flood risks and the provision of recreation opportunities (Tomscha et al., 2017). A case in point is the Lahn river landscape, situated in Germany, where several initiatives are currently underway to explore the provision of ecosystem services to people, to understand the human contributions, and to design comprehensive strategies for sustainable landscape development in the future (Albert et al., 2019; 'LiLa Project' website).

Therefore, the aim of this paper is to assess the self-perceived and attributed engagement and importance of stakeholders in the co-production of ecosystem services in thea case study of the Lahn river landscape, Germany. More specifically, we investigate two main research questions:

- How do local stakeholders perceive their own engagement in the co-production of ecosystem services in the case study area?
- What differences and commonalities similarities exist between self-perceived and attributed importance in ecosystem services co-production?

Analyses of perceived and attributed importances of stakeholders' roles in ecosystem services co-production, as well as of potential differences, may provide useful insights regarding relationships in actor networks engaged in ecosystem services management. While information on perceived importances reveals how actors see their own responsibilities, information on attributed importances illustrates perceptions from others (Fischer and Eastwood, 2016; Gissi and Garramone, 2018). Understanding the differences can help explain inadequate ecosystem services management, where some actors are not aware of, or do not want to assume, the responsibility of ecosystem services management that other actors attribute to them. Vice versa, some actors might assign responsibilities to others who, in effect, do not have the capacities and intention to fulfill this role (Opdam et al., 2015; Loft et al., 2015). Taking this information into account can help planning, management, and governance of ecosystem services (Mann et al., 2015; Sattler et al., 2018).

The paper is structured as follows. First, we describe the Lahn river landscape study case together with the explanation of important components of the research: 'Stakeholders involved' and 'Local ecosystem services' before. Second, we presenting the methodological approach,s for data collection, and analysis. After describing our results, we discuss these with respect to their implications for co-production of ecosystem services and governance structures.

2. Methods

21.1 ,1 Case study description: the Lahn river landscape case study

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The case study site is the Lahn river landscape, whose river basin contains about 5.931 km^2 and is situated in the German federal states of Hesse (4.756,6 km^2), North Rhine-Westphalia (181,3 km^2) and Rhineland-Palatinate (992,7 km^2) (RP Gießen 2005) (Fig. 2). The river originates near Lahnkopf and flows around 240 km from the estuary into the Rhine near Lahnstein, one of the most important rivers of Europe. There are around 1 million people living in the region, notwithstanding the tourists who use the Lahn and its surroundings for outdoor activities after work, on weekends, or during holidays.

The river's ecological condition and the ecological potential are currently evaluated as "not satisfying" or "bad" (Umweltbundesamt, 2017). In the course of the Lahn valley's urbanization through e.g., the allotment of areas for settlement and agriculture, landward traffic infrastructure, mining, waterpower, and shipping, the river's natural development was restricted through diverse dams, watergates, and boat channels. Today, around 150km in the lower part of the river is are still

a federal waterway. The historic use of the river as a transportation route for goods has been abandoned, and today the river is ~~today~~ used only for recreational navigation. Recently, however, the Administration of Federal Waterways declared the Lahn a~~s~~ secondary waterway (BMVI, 2016), thus emphasizing its inferiority as a federal transportation route. In addition, the federal "Blue Ribbon" Program (Blaues Band Deutschland, 2017)~~,~~ initiated to further enhance the ecological quality of all German rivers, openings~~s~~ a window of opportunity. A needs-based adjustment of existing infrastructure opens up a new scope for natural developments and the restoration of ecological patency. The potential of~~at~~ the Lahn river is fathomed in a current Lahn river development concept.

The study presented here is part of the PlanSmart research project to investigate novel approaches to the planning and governance of nature-based solutions in river landscapes (Albert et al. 2019). The research also relates to and cooperates with an ongoing integrated EU Life Project "Living Lahn – one river, many interests" (known as the 'Lila Project') which aims "to enhance the ecological health and connectivity of the river itself while simultaneously enriching the quality of life along the river." (https://www.lila-livinglahn.de/en/the-project/project-goals/) As part of the LiLa project, a diverse group of stakeholders have~~s~~ been consulted to develop concepts for securing a good ecological state of the river Lahn, sustainably protect against flooding, and facilitating nature-based tourism. Local stakeholders such as owners of local businesses, public sector workers, and citizens in general were invited to take part in~~in~~ workshops to identify their respective interests and to take them into account in the subsequent planning process. As a result of these workshops the stakeholders built eight thematic working groups who then periodically met to develop a paper on the key goals of their group. ~~Eight groups of local stakeholders were identified which shared common interests related to the same topics.~~ Those eight stakeholder groups were formed around the topics of 'Nature and Ecology', 'Recreational Motor Boating', 'Rowing and Canoeing', 'Agriculture, Forestry and Hunting', 'Water Management', 'Tourism and Local Recreation', 'Municipal Development and Land Planning' and 'Recreational Angling'. Stakeholders could freely decide which working group they wanted to participate in. In the herein reported research, we apply the same stakeholder groups.

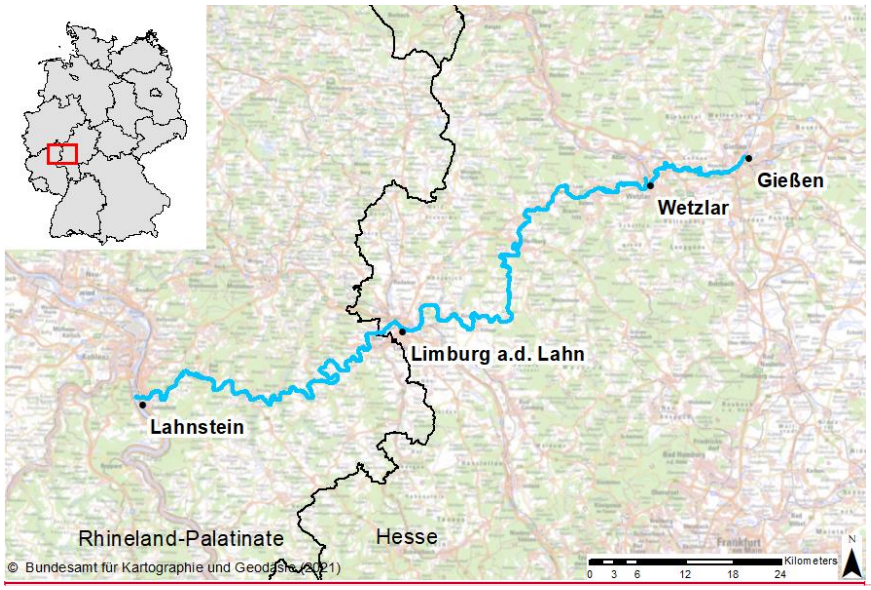


Figure 2: The case study, the Lahn river located in central-west Germany.

~~3.~~ ~~Methods~~

2.2. Methodological Approach: Social Network Analysis (SNA)

To answer our research questions we used a combination of Social Network Analysis (SNA) and descriptive statistics. SNA is an approach for analysing social relations and their structures based on graph theory (Scott, 1988; Prell 2012). We analyzed the networks of collaboration amongst the stakeholders. To determine the importance of actors in the networks we used the SNA measures of centrality and calculated the actors in-degree centrality and out-degree centrality. If an actor is more central in the network, he/she is~~/they are~~ more important for the whole collaboration network as he/she is/they are cooperating more with other actor groups for certain ES. We ~~did~~ distinguished between in-degree and out-degree centrality. Degree centrality measures the number of immediate contacts an actor has in a network. In-degree centrality measures the number of ties received by an actor from others, while out-degree centrality measures the number of ties given by that actor to others (Prell, 2011). High degree centrality of a node in a network points to the importance that a node has respective to all other nodes in the network, since that node has a high number of connections in that network. Derived from that, in our interpretation, high in-degree and out-degree centrality also shows importance, but in opposite ways. Keeping ~~Having~~ in mind that our respondents were asked to give a self-reported perspective, a high in-degree centrality indicates how important stakeholders are perceived by others.~~—~~ A~~a~~ stakeholder's in-degree value of~~equal~~

Commented [CJD1]: Colors should be used to highlight the river (in blue) and the square in the country map (red)

13 shows it was mentioned 13 times by other stakeholders when they were asked to identify with whom they were collaborating. If a stakeholder's in-degree value is low, it means it was mentioned by a small number of other stakeholders. Out-degree centrality informs instead on each stakeholder's self-perceived importance. ~~—~~ A~~a~~ stakeholder's out-degree value of~~equals~~ five shows that that particular stakeholder reported collaborating with five other stakeholders. Based on this interpretation of in-degree and out-degree centralities, we consider in-degree centrality a representation of attributed importance ("How many different stakeholders identified me as connected with them?"), and out-degree centrality of self-perceived importance ("With how many stakeholders I identify myself connected?").

2.3 ~~3~~2 ~~.1~~ Data collection - online survey

For data collection, we chose a quantitative methodology based on a short online survey regarding the perspectives of local stakeholders in the Lahn region on ecosystem services co-production. ~~For data collection this research we chose a quantitative methodology based on a short online survey amongst local stakeholders in the Lahn region regarding their perspectives on ecosystem services co-production.~~ In July 2018, the online survey was sent to a total of ~~altogether~~ 98 representatives of the above (Section 2.1) ~~mentioned~~ eight stakeholder~~s'~~ groups, as established by LiLa (Table 1). A total of 57 completed online questionnaires were returned (response rate of 55,87%).

~~Participants in the survey had the opportunity to mention new stakeholder groups in addition to the eight pre-determined groups, resulting in six extra ones. To establish the link of interest to ecosystem services, we added t~~These ~~new groups as were seen as relevant to the the~~on the networks~~'~~ collaboration of local ecosystem services co-production. These are: 'Private Business', 'Education', 'Other Government Agencies', 'Family and Friends', 'LiLa', and 'Local Clubs and Associations' (Table 1).~~.~~

Table 1 - List of the fourteen stakeholder groups (eight~~h~~ considered since the beginning of the study ~~plus six added by the interviewees).~~ Included is a brief explanation of who they are and the number of people who took part in the survey.

Stakeholder group	Description	Nº of respondents
Nature and Ecology	People and institutions (public, private or NGO) focused on nature conservation (ex: State-Society for Nature Protection and Ornithology and National Nature Protection Association)	8

Recreational Motor Boating	People and organizations which rely on motorboats for different economic activities (ex: shipping enterprises and motor shipping associations)	11
Rowing and Canoeing	People and organizations which rely on muscle-driven boat~~s~~ rentals for tourism and sports (ex: regional rowing association and local tourist association)	8
Agriculture, Forestry and Hunting	People and institutions focused on the management of agricultural and forest land and its biodiversity (ex: farmers and Regional Administration for Rural Development)	3
Water Management	People and the public institution responsible for local water management (ex: citizens and ~~group on~~ water and gardening groups)	5
Tourism and Local Recreation	People and institutions responsible for touristic and recreational activities (ex: city representatives and tourist information groups)	7
Municipal Development and Land Planning	Public institutions responsible for municipal development and land planning (ex: city and regional representatives)	4
Recreational Angling	Institutions and groups of people who have fishing as a leisure activity (ex: Sport Fishing Clubs and Fishing Administration)	7
~~*Private Business*~~	~~Private business of different activities, excluding directly related to tourism and boats (ex:~~	-

	ice cream sellers and winemakers)	
Education	People and institutions related to education formally or informally (ex: local schoolteachers and universities)	-
Other Government Agencies	Different governmental agencies, which were not listed before (ex: general public authorities)	-
Family and Friends	People related to the interviewees in personal context	-
LiLa	Decision makers from institutions of different levels and focuses joining the same European Life Project	-
Local Clubs and Associations	Local hobby clubs or interest associations (ex: sports, history, beekeepers, nature conservation and religion)	-

3~~2~~.23 ~~Local ecosystem services~~

The selection of the ecosystem services included in the study was based on a list of ecosystem services for German landscapes (Podschun et al., 2018), which in turn was inspired by the practically relevant TEEB project (2010). In addition, consultation with local actors was applied to adapt the list from Podschun et al. (2018) to the very specific context conditions of the Lahn river landscape and to suit it to stakeholder understandings. Through a short survey delivered to partners from the LiLa project, the authors determined a preliminary set of priority ecosystem services for the region. The set considered twelve ecosystem services evaluated as important by at least one respondent: 'Food', 'Freshwater', 'Habitat for Species', 'Moderation of Flooding Events', 'Local Climate and Air Quality', 'Carbon Sequestration and Storage', 'Pollination', 'Historical and Cultural Meaning', 'Aesthetic Appreciation', 'Recreation and Tourism', 'Hydropower Energy' and 'Aquatic Sports and Recreational Shipping''.

The questionnaire was conducted in German with the use of simplified explanations instead of specific scientific terms.~~The questionnaire was conducted in German and and there was careful attention to not bring specific scientific terms, but instead, simplified explanations~~. It contained 34

questions distributed oerin four main categories: a) Socio-demographicy; b) Co-production of ecosystem services; c) Collaboration with other stakeholders for the co-production of ecosystem services; d) Influence on ecosystem services management (for the whole questionnaire see supplementary material). The number of questions posed to each participant depended on the answers provided to some core questions. Respondents were asked to report if they felt they were taking part in any activity related to ecosystem services, i.e., if they considered themselves as being co-producers of each ecosystem service presented and if they collaborated with other stakeholders to promote that co-production.

Regarding the questions about collaboration for ecosystem services co-production, the respondents were able to identify stakeholders they collaborated with. It was also possible to actively include stakeholders that were not listed in the survey.

Data collection took place during May - June /2018. An invitation was sent via e-mail to all potential respondents. The survey was open for almost four weeks and, in the meantime, a reminder e-mail was sent. Data collection took place during May….Month/Year... It was open for two weeks. An invitation was send per email. After...time a reminder email was sent.

2.4 32.34 Data analysis

For the analysis of the stakeholders' positions in the networks, SNA measures were calculated using the software for social network analysis UCINET 6 (Borgatti et al., 2002). We chose to use non-reciprocated collaboration ties, i.e., a an indication of collaboration indicated from only one side would be understood as a potential reciprocated tie. We also decided to use unweighted links, in order to avoid underestimating potential existing links that were not mentioned by a group with a reduced number of respondents.

32.34.1 Network definition – The networks for the co-production of ecosystem services were defined based on responses about the collaborative relationships each respondent perceived being a part of. Each respondent was asked to identify him/herself as being part of one stakeholder group. Consequently, the group answers represent the merged responses provided by the respondents included in that specific group. We therefore constructed networks representing patterns of collaboration for the co-production of each ecosystem service. Each node represents one stakeholder group and the links represent whether collaboration between the groups exists. In total, twelve12 networks were created, one for each ecosystem service. Every time one respondent identified a link of collaboration with another actor, a link was added between the two stakeholder groups to which the respondent and the partner respectively belonged.

32.34.2 Defining the stakeholders' positions – for the analysis of the stakeholders' positions in the networks, SNA measures were calculated using the software for social network analysis UCINET 6 (Borgatti et al., 2002). We chose to use non-reciprocated collaboration ties, i.e. an indication of

collaboration from only one side would be understood as a potential reciprocated tie. We also decided to use unweighted links, in order to avoid underestimating potential existing links that were not mentioned by a group with a reduced number of respondents.

32.34.3 Indegree and outdegree centralities – we calculated the stakeholders' indegree and outdegree centrality for the co-production networks to find out which stakeholders are more important than others for the co-production of certain ecosystem service. Degree centrality measures the number of immediate contacts an actor has in a network. Indegree centrality measures the number of ties received by an actor from others, while outdegree centrality measures the number of ties given by that actor to others (Prell, 2011).

High degree centrality of a node in a network points to the importance that a node has respective to all other nodes in the network, since that node has a high number of connections in that network. Derived from that, in our interpretation, high indegree and outdegree centrality also show importance, but in opposite ways. Having in mind that our respondents were asked to give a self-reported perspective, a high indegree centrality indicates how important stakeholders are perceived by others – a stakeholder's indegree value equal 13 shows it was mentioned 13 times by other stakeholders when they were asked to identify with whom they were collaborating. If a stakeholder's indegree value is low, it means it was mentioned by a small number of other stakeholders. Outdegree centrality informs instead on each stakeholder's self-perceived importance – a stakeholder's outdegree equals five shows that that particular stakeholder reported collaborating with five other stakeholders. Based on this interpretation of indegree and outdegree centralities, we consider indegree centrality a representation of **attributed** importance ("*How many different stakeholders identified me as connected with them?*"), and outdegree centrality of **self-perceived** importance ("*With how many stakeholders I identify myself connected?*")

For the 32.34.4 vVisual interpretation of the networks – network graphs were generated with the help of the Flourish.studio website tools. Across all twelve analyzed networks, the colors used to represent each stakeholder remaineds the same. Two sizes of nodes were are used, with "big size" nodes to represent highest centrality (in some networks there is more than one node with the highest value), the "small size" to illustrate all the other ones.

34. Results

Participants in the survey had the opportunity to mention new stakeholder groups in addition to the eight pre-determined groups, resulting in six extra ones. To establish the link of interest to ecosystem services, we added these new groups as they were seen as relevant to the theon the networks´ collaboration of local ecosystem services co-production. These are: 'Private Business', 'Education', 'Other Government Agencies', 'Family and Friends', 'LiLa', and 'Local Clubs and Associations' (Table 2).

Table 2 - List of the six extra stakeholder groups added by the interviewees in their responses. Included is a brief explanation of who they are.

Extra stakeholder group	Description
Private Business	Private businesses of different activities, excluding directly related to tourism and boats (ex: ice -cream sellers and winemakers)
Education	People and institutions related– to formal and informal education ~~formally or informally~~ (ex: local schoolteachers and universities)
Other Government Agencies	Different governmental agencies~~,~~ which were not listed before (ex: general public authorities)
Family and Friends	People related to the interviewees in personal context
LiLa	Decision makers from institutions of different levels and focuses on joining the same European Life Project
Local Clubs and Associations	Local hobby clubs or interest associations (ex: sports, history, beekeepers, nature conservation, and religion)

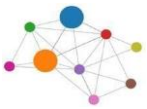
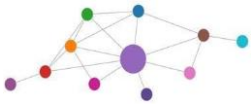
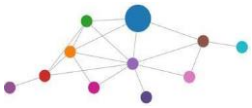
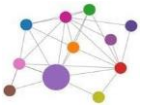
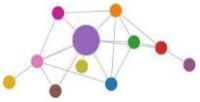
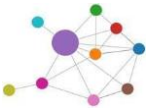
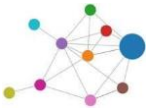
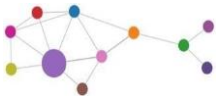
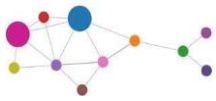
3.1 Relative importance and centrality of stakeholders in ecosystem services co-production

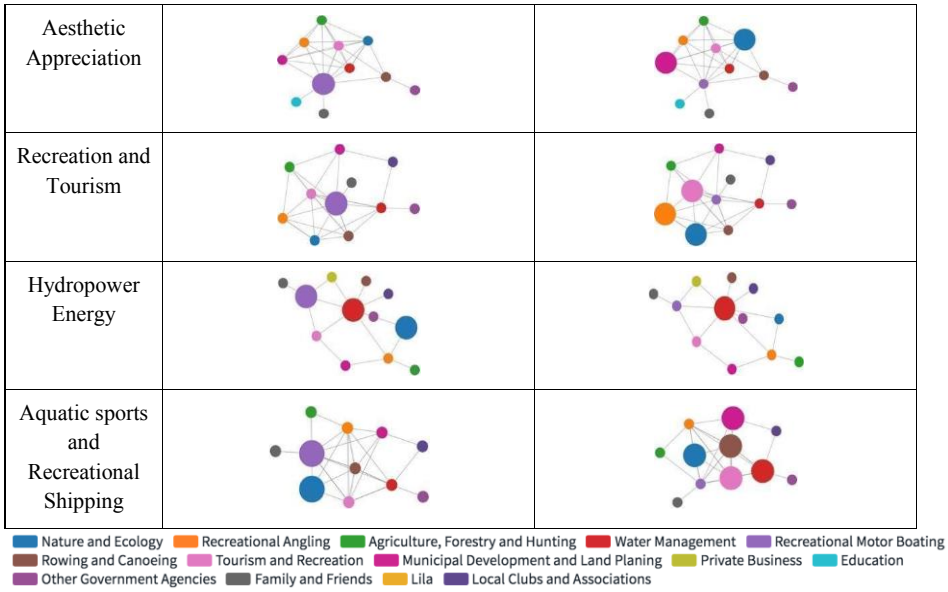
A diverse set of collaboration relations between stakeholders in the co-production of ecosystem services was identified, with differences between perceived and attributed perceptions (~~Fig.~~Table ~~3~~2). Comparison between each network of the same pair (i.e., for the same ecosystem service) shows consistency of stakeholders involved (same colors) and the distribution of the links among them (i.e., the network overview looks similar in the same pair).

The size of the nodes is the biggest discrepancy in the pairs. It represents the centrality value, understood here as the importance of that stakeholder in the network. Big nodes have the highest centrality value, while the small ones have smaller values. There was not a single pair for which in both networks the biggest node was the same ~~one~~. This shows that self-perceived and attributed views strongly differ on which stakeholder is the most influential for the co-production of that ecosystem service. The 'Hydropower Energy' network is the only ecosystem service which shows the same stakeholder as the most important on both networks, but with an important difference between the two networks. While the stakeholder 'Municipal Development and Land Planning' is indeed the biggest node in both networks, it is the only one on the attributed perspective. In the network constructed on self-perceived perspectives, it shares its position with two other stakeholders ('Recreational Motor Boating' and 'Nature and Ecology'). Another important insight that we obtain from this analysis is ~~thus~~ that the exclusiveness of one node's importance is not always maintained on both perspectives. In almost half of the cases, it is shared by two or more

stakeholders. In most of the cases, it is shared on the attributed perspective, while it is exclusive on the self-perception one (with the exception in the 'Hydropower Energy' case).

Table 3 - Networks of collaboration between stakeholders on the co-production of twelve ecosystem services.

Ecosystem Services	Self-Perceived	Attributed
Food		
Freshwater		
Habitat for Species		
Moderation of Flooding Events		
Local Climate and Air Quality		
Carbon Sequestration and Storage		
Pollination		
Historical and Cultural Meaning		



The ~~Figure 2: Networks of collaboration between stakeholders on the co-production of~~ twelve ecosystem services are~~:~~ Food, Freshwater, Habitat for Species, Moderation of Flooding Events, Local Climate and Air Quality, Carbon Sequestration and Storage, Pollination, Historical and Cultural meaning, Aesthetic Appreciation, Recreation and Tourism, Hydropower Energy and Aquatic Sports and Recreational Shipping. Each stakeholder is represented by the same node color on the different networks. There are two sizes of nodes: big (represents the stakeholders with the highest centrality value), small (represents stakeholders with smaller centrality values). Sizes vary depending on centrality measures for each of the networks.

3.2 Differences between perceived and attributed stakeholder roles

The number of networks each stakeholder participates in, from self-perceived and attributed perspectives, is illustrated in figure 3. This figure shows another illustration on how different the two perspectives are for each stakeholder. In general, stakeholders' self-assessment of their participation seems to correspond to what others think of them. The biggest discrepancy is the case of 'Municipal Development and Land Planning', which perceives themselves as of relevance in only half the number of collaboration networks compared with what is attributed to it. 'Recreational Motor Boating' and 'Nature and Ecology' also showed substantial differences between both perspectives. For the former~~irst one~~, the self-perceived level is higher than the attributed level, for the latter the opposite is true.

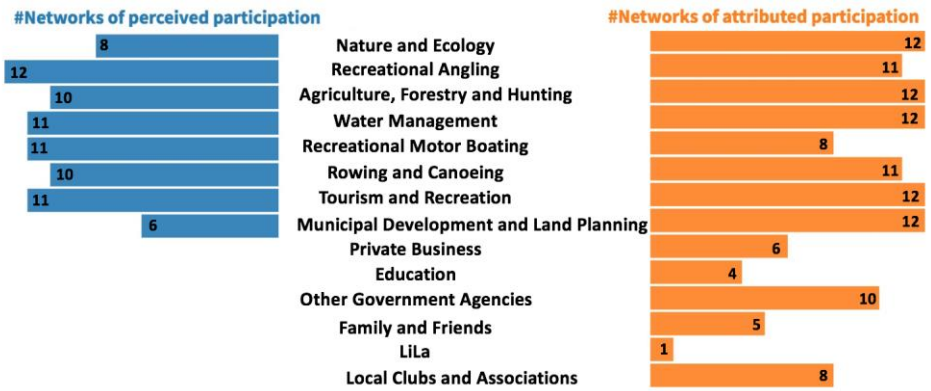


Figure 3: Number of collaboration networks for the ecosystem services co-production that each stakeholder perceives themselves participating in (#Ne*tworks of perceived participation*) and the number of networks in which others consider them to participate in (*#Networks of attributed participation*).

The most important stakeholder for collaboration on each ecosystem service co-production can be observed in figure ~~4~~. In the middle, there is a list of the twelve ecosystem services. The left row shows which stakeholders perceived themselves as most important for the co-production of the ecosystem services linked to them. The right row illustrates stakeholders that were identified by others as most important for the ecosystem services as shown by the curved lines. A comparison shows that stakeholders' attributed significance in all the ecosystem services networks is more spread than self-perceived importance. For the twelve networks, four stakeholders perceived themselves as having the highest importance, in contrast to six stakeholders being attributed as the most important. Besides~~,~~ in the attributed perspective, there is a greater distribution when analyzing the number of important stakeholders for each ecosystem service. Six ecosystem services present a shared central role among two or more stakeholders in the attributed perspective, in comparison with two in this situation o~~n~~ the self-perceived perspective.

Comparing the self-perceived versus the attributed perspective, only three stakeholders appear on~~appears in~~ both sides ('Municipal Development and Land Planning', 'Recreational Angling' and 'Water Management'). 'Recreational Motor Boating' perceive themselves as the most important in eleven networks, but they do not appear in none of the attributed perspectives. The opposite situation occurs with 'Nature and Ecology'.~~,~~ W~~w~~hile they do not show a self-perception in any central role, it is attributed to them in ten of these roles. In the case of 'Rowing and Canoeing' and 'Tourism and Local Recreation', both only appeared in the attributed perspective.

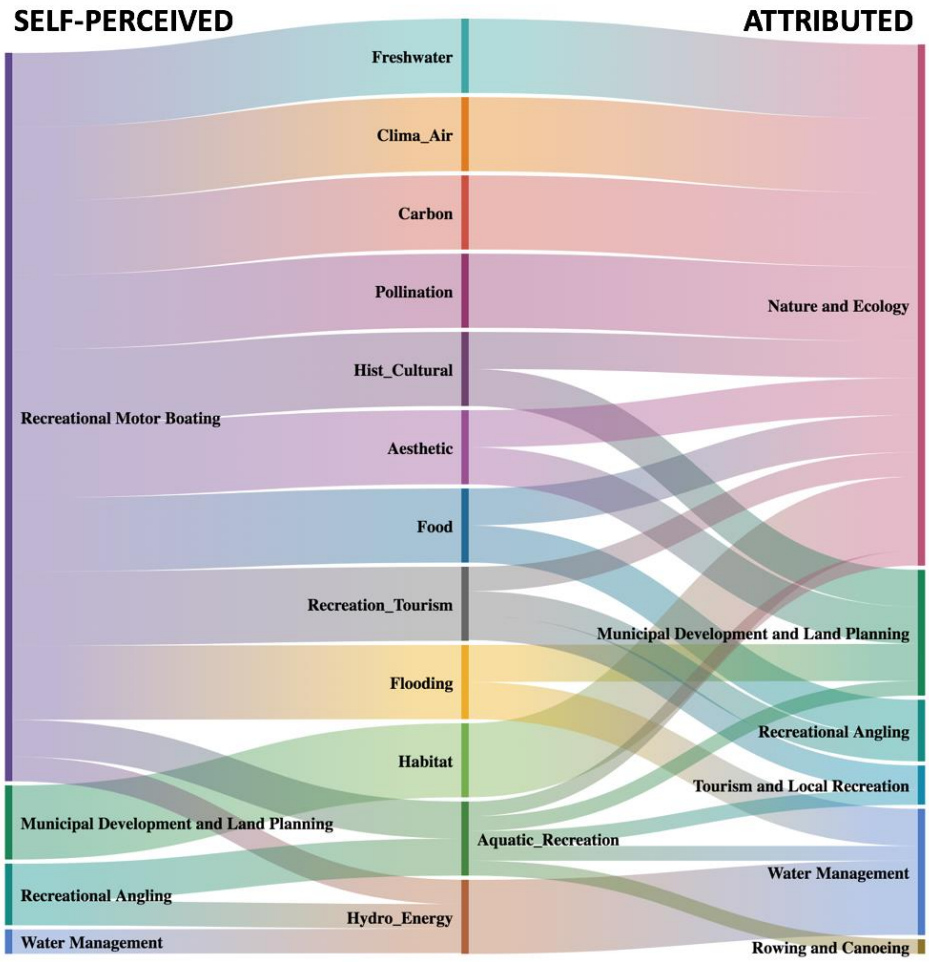


Figure 4: Illustration of differences in the self-perceived and attributed identification of the most important stakeholder (central role) in the co-production for each of the twelve selected ecosystem services. The left row shows which stakeholders perceived themselves as most important for the co-production of the one or more ecosystem services linked to the stakeholder. The right row illustrates stakeholders that were identified by others as most important for one or more ecosystem services as shown by the curved lines. In the middle, the ecosystem services are listed as follows: Freshwater, Local Climate and Air Quality (*Clima_Air*), Carbon Sequestration and Storage (*Carbon*), Pollination, Aesthetic Appreciation (*Aesthetic*), Moderation of Flooding Events (*Flooding*), Historical and Cultural meaning (*Hist_Cult*), Habitat for Species (*Habitat*), Food, Aquatic Sports and Recreational Shipping (*Aquatic_Recreation*), Recreation and Tourism (*Recreation_Tourism*), Hydropower Energy and Aquatic Sports (*Hydro_Energy*).

3.3 Stakeholders´ net importance in ecosystem services co-production

An analysis of the difference between the self-perceived and attributed perspectives regarding each stakeholders´~~s~~ net importance on each collaboration network is presented in figure 5. According to this figure, if the self-perceived perspective is higher than the attributed one, we understood the stakeholder to have ~~has~~ an overestimation of her/his importance on that specific network. The contrary is true. If the attributed perspective has a higher value than the self-perceived one, the stakeholder is considered to have an underestimation of her/his role on that network. In general, there is a tendency of underestimation among the stakeholders, meaning that stakeholders tend to perceive ~~more~~ the importance of others more than of themselves. From 96 cells that could have the same value for perceived and attributed importance (P=A), only ten fell in this category. This means that only in ten cases ~~there~~ was there no under- or overestimation. ~~,~~ This ~~it~~ means the perception of the level of importance between the self-perceived and attributed perspectives was the same. 'Water Management' is the stakeholder that shows a better balance between the two perspectives. 'Nature and Ecology' and 'Municipal Development and Land Planning' are stakeholders who ~~show~~ more frequently show a higher underestimation perspective. While, in contrast, 'Recreational Motor Boating' and 'Recreational Angling' have a higher overestimation perspective~~one~~.

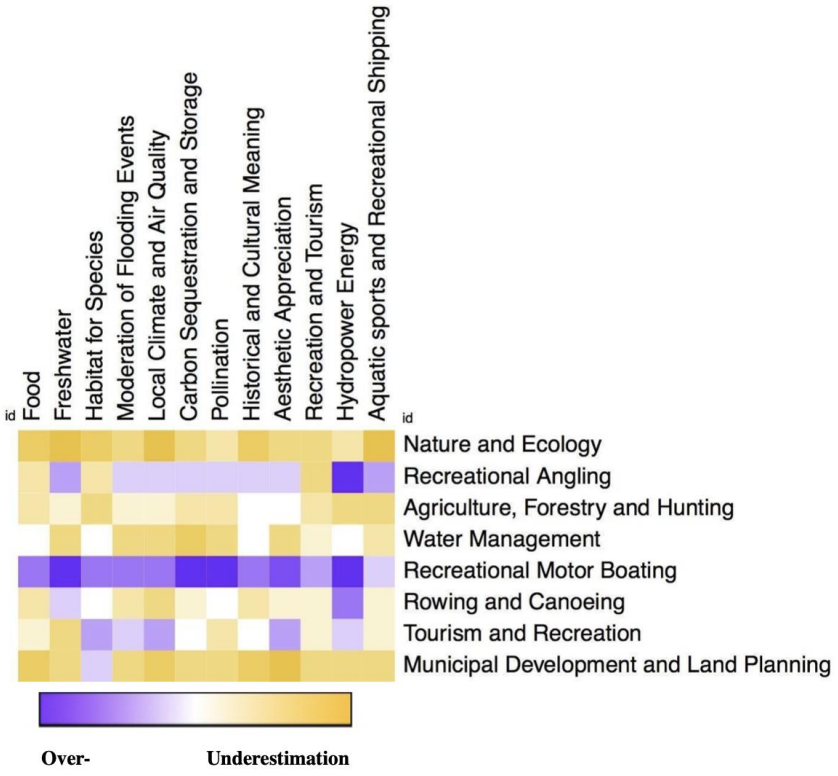


Figure 5: Cartesian heatmap representing the overestimation (dark purple) and underestimation (dark yellow) of each stakeholder's net importance on the collaboration networks for all the ecosystem services co-production. The estimations were calculated by the difference (P-A) between the perceived (P) and attributed (A) importance.

45. Discussion and conclusion

This paper provided insights regarding the engagement of relevant stakeholders in the co-production of local ecosystem services in the Lahn river landscape. More specifically, our paper sheds new light on commonalities and differences between self-perceived and attributed roles of stakeholders in ecosystem services co-production in the specific case study. To our knowledge, this paper presents the first assessment on the self *vs* attributed perspective in the ecosystem services context in general. It therefore constitutes an innovative approach to the co-production of the ecosystem services scholarship. We conclude by ~~with a reflection on key~~ highlighting key implications for ecosystem services governance, among others the need to ~~including the issue of how to~~ address power imbalances and to foster collaborative engagement for ensuring sustained and just ecosystem services delivery.

Studies on self-perceived and attributed stakeholder roles in ecosystem services co-production provides an important and hitherto rarely considered lens in this thematic. As stated by Fischer and Eastwood (2016), people's identities, i.e., the way they perceive themselves, shape ecosystem services co-production. There is a complex interaction between ecological and social factors that results in ecosystem~~on ecosystem~~ services creation, and ~~the~~ people's perceptions, alongside with needs and values, is an important part of that (Gissi and Garramone, 2018). This study in particular explores ~~perception of self in respective to others and vice-versa, for which we found social network analysis particularly useful. Indeed, social network analysis allows to reflect on~~ actors' position in a particular configuration of social relations through social network analysis. The usefulness of social network analysis for the study of ecosystem services has recently been highlighted in diverse studies. For example, Lopes and Videira (2016) used it as part of a collaborative process; Cárcamo et al. (2014) instead deployed the method to reflect on different links between ES, uses, and biodiversity features. With this article we want to contribute to the literature that brings social network analysis to the study of ecosystem services, by focusing on actors' perception of self in respect~~ive~~ to others and vice-versa.

Ecosystem services have tremendous potential to connect people, both conceptually and practically, which in a landscape context can potentially promote collaborative actions towards common goals or solutions towards adversity (Opdam et al., 2015). This affirmative dialogue~~s~~ with our research, since an agreement between both perceptions of the collaborations established (who is involved, the links established etc.) could show a tendency of group cohesion for ecosystem service co-production. For instance, if others perceive you the way you perceive yourself, it can mean your skills and commitment are perceived adequately by the group and yourself and therefore can be openly discussed and negotiated, promoting alignment of expectations. This might be the case of increasing chances to succeed collectively in the face of a challenge. In general, the results show similarities ~~similarity~~ between self-perceived and attributed positions in the networks of collaboration for the co-production of twelve different ecosystem services. The networks structure, their size (how many nodes and links are presented), which nodes are involved, and how the links are distributed are very similar when comparing the self and attributed perspectives. There is no literature regarding ecosystem services which brings related discussions.

~~An analysis related to the central role is how it is distributed on each network.~~ In the self-perceived perspective, ~~it~~the central role is highly concentrated in one actor (by 'Recreational Motor Boating') and poorly distributed[1] (by four stakeholders), while in the attributed perspective there is a better distribution (by six stakeholders), but the concentration is still high (by 'Nature and Ecology). From

[1] High concentration and wide distribution is possible in this analysis since a network can have as many central roles as its number of nodes.

these results, there is a tendency of concentrating the central role for each ecosystem service co-production on one stakeholder group, although taking into consideration that this group is composed ofby different actors.

Our results show a relevant difference between the attributed and self-perceived importance (in-degree and out-degree values). In other words, how stakeholders perceive their own importance on a network is not the same way how other stakeholders perceive it. Within each network, differences exist between the stakeholders assuming central roles in ecosystem services co-production with respect to the self-perceived and attributed perspectives. An overestimation of a stakeholder's role is particularly prominent with respect to some groups, while others show an underestimatedion attitude, and few perceive their roles relatively in line with others. These differences could demonstrate a power imbalance or even a current conflict shown by the (un) conscious mention of themselves and other stakeholders. Zoderer et al. (2019) considered the discrepancy between stakeholders' perspectives in supply and demand bundles of ecosystem services, which also lead to conclude the potential existence of conflicts and power imbalance. The authors argued that such conflicts could be avoided if processes of ecosystem services and landscape management would include stakeholders' perspectives from the outset and make these mismatches visible to everyone involved. In addition to what was brought to the discussion by Zoderer et al. (2019), we argue that studying both the self-perception and attributed perspectives is necessary in order to have a clear understanding of who is involved and their importance in the networks of ecosystem services co-production. This information can in a first step help to explain mis-management or too little stewardship of ecosystem services, resulting in sub-optimal provision and potentially deficits. And In a second step, it can help to develop better governance models that either provide relevant information, e.g., to inform stakeholders of what responsibilities they have given their mandate or existing regulations, or to provide incentives for stakeholders who so far do not assume full responsibility.

In addition, the differences in perception of participation and role in the networks for the co-provision of certain ecosystem services, allow to discuss more openly diverging interests and value systems and to negotiate trade-offs in the provision of these ecosystem services (Loft et al., 2015; Mann et al., 2015). Finally, our study contributes in generating knowledge and providing information about the linkages between ecosystem services and how they are provided, more specifically, who is co-responsible for their provision. Finally, our stakeholder analysis for co-production of ecosystem services is generating knowledge and providing information about the linkages between different ecosystem services and their provision. n which Aaccording to Loft et al. (2015) this understanding isis still a huge research gap as "precise and measurable information on the status and quality of ecosystem services provision is often missing" (Loft et al., 2015).

~~Another analysis related to the central role is how it is distributed on each network. In the self-perceived perspective, it is highly concentrated (by 'Recreational Motor Boating') and poorly distributed[2] (by four stakeholders), while in the attributed perspective there is a better distribution (by six stakeholders), but the concentration is still high (by 'Nature and Ecology). From these results, there is a tendency of concentrating the central role for each ecosystem service co-production on one stakeholder group, although taking into consideration that this group is composed by different actors.~~

Our analysis further addresses some challenges of governance for ecosystem services. It sets a basis to designing governance structures and policy instruments in a more inclusive and adaptive process (Loft et al., 2015). A first step for this is becoming aware of who are the actors involved in co-production of ecosystem services~~,~~ U~~u~~sing both self-perceived and attributed measures is useful for this. Based on this, the design of governance structures can be changed, for instance from top-down models to multi-stakeholder governance as adaptive management, co-management, or community-based management (Mann et al., 2015). Particularly, stakeholders that have not necessarily been included in participatory models when first designed~~,~~ can be invited at a later stage if they are found to have key roles in the co-production of ecosystem services. The discussion about governance highlights the need for a better inclusion of the range of concerned stakeholders for ecosystem service supply and demand. As concerned stakeholders, their ideas, motives, and interest need to be better integrated, which means community-based, participatory or multi-actor governance approaches are needed in order to get everyone informed about their interests, values and motivations, interpretations of problems and solutions, and struggles over needs and demands (Sattler et al., 2018)~~,~~ a~~A~~ddressing the challenge of "Balancing actors' interests and values" (Loft et al., 2015). In this sense, our methodology supports the gathering of this knowledge. The dynamics of asking self-perception versus attributed perspective reveal the stakeholders' view and interpretation of ecosystem service co-production and may also lead to inclusion of new actors (addressed by the interviewees) into the respective co-production networks.

~~In addition, the differences in perception of participation and role in the networks for the co-provision of certain ecosystem services, allow to discuss more openly diverging interests and value systems and to negotiate trade-offs in the provision of these ecosystem services (Loft et al., 2015; Mann et al., 2015). Finally, our study contributes in generating knowledge and providing information about the linkages between ecosystem services and how they are provided, more specifically, who is co-responsible for their provision.Finally, our stakeholder analysis for co-production of ecosystem services is generating knowledge and providing information about the linkages between different ecosystem services and their provision which Aaccording to Loft et al.~~

[2] ~~High concentration and wide distribution is possible in this analysis since a network can have as many central roles as its number of nodes.~~

~~(2015) this understanding is~~is still a huge research gap as "precise and measurable information on the status and quality of ecosystem services provision is often missing" (Loft et al., 2015).

Limitations of our study can be found in the method. Because of the shortness of this project and the relatively large original sample size, we decided to apply the survey as an online survey. This prevented us from getting~~to get~~ some additional qualitative information and narratives on the reasons why the different groups collaborate in the provision of a certain ecosystem service and ~~on~~ examples of how these collaborations unfold. The results are further limited to the identified interest groups which at this point participated in the development of the river management concept.

Additionally, our study exclusively focuses on actors' perceptions and therefore does not get into the interdependencies between ES, while we acknowledge that these exist (Lopes and Videira, 2017). An interesting avenue for future research would be to investigate whether actors' perceptions of involvement also reveal existing ES interdependencies. Up to now, no information on the status and trends of ecosystem services provision and demand has been published for the Lahn river. However, the generally poor ecosystem quality of the Lahn river according to the EU water framework directive suggests that the transformation of the river and its floodplain may have resulted in positive impacts for some ecosystem services (such as agriculture in the former floodplain area) but also negative impacts on several other, primarily regulation ecosystem services (such as water retention, nitrogen retention, carbon storage). A promising field for future research is also to explore relations between perceived and attributed importance on the one hand, and the actual management of ecosystem services, or their conservation status, on the other hand.

~~5~~6. Acknowledgments

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~~6~~7. References

Albert, C., Schroeter, 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? Landscape and Urban Planning. 182, 12-21. https://doi.org/10.1016/j.landurbplan.2018.10.003.

Albert, C., Bonn, A., Burkhard, B., Daube, S., Dietrich, K., Engels, B., Frommer, J., Götzl, M., Grêt-Regamey, A., Job-Hoben, B., Koellner, T., Marzelli, S., Moning, C., Müller, F., Rabe, S-E., Ring, I., Schwaiger, E., Schweppe-Kraft, B., Wüstemann, H., 2016. Towards a national set of ecosystem service indicators: Insights from Germany. Ecological Indicators. 61:1, 38-48. https://doi.org/10.1016/j.ecolind.2015.08.050.

Andersson, E., Langemeyer, J., Borgström, S., McPhearson, T., Haase, D., Kronenberg, J., Barton, D. N., Davis, MK., Naumann, S., Röschel, L., Baró, F., 2019. Enabling Green and Blue Infrastructure to Improve Contributions to Human Well-Being and Equity in Urban Systems. BioScience. 68 (7), 566-574. https://doi.org/10.1093/biosci/biz058.

Berbés-Blázquez, M., González, J.A., Pascual, U., 2016. Towards an ecosystem services approach that addresses social power relations. Current Opinion in Environmental Sustainability. 19, 134-143. https://doi.org/10.1016/j.cosust.2016.02.003.

BMVI (2016). Bundesverkehrswegeplan 2030, Bundesministerium für Verkehr und digitale Infrastruktur, Berlin.

Blaues Band Deutschland, 2017. Bundesprogramm Blaues Band Deutschland Eine Zukunftsperspektive für die Wasserstraßen – beschlossen vom Bundeskabinett am 1. Februar 2017.

Borgatti, S. P., Everett, M. G., Freeman, L. C., 2002. Ucinet 6 for Windows: Software for Social Network Analysis. MA: Analytic Technologies, Harvard.

Burkhard, B., Kandziora, M., Hou, Y., Müller, F., 2014. Ecosystem Service Potentials, Flows and Demands – Concepts for Spatial Localisation, Indication and Quantification. Landscape Online. 34 (1): 1-32. https://doi.org/10.3097/LO.201434.

Daniel, T.C., Muhar, A., Arnberger, A., Aznar, O., Boyd, J.W., Chan, K.M.A., Costanza, R., Elmqvist, T., Flint, C.G., Gobster, P.H., Grêt-Regamey, A., Lave, R., Muhar, S., Penker, M., Ribe, R.G., Schauppenlehner, T., Sikor, T., Soloviy, I., Spierenburg, M., Taczanowska, K., Tam, J., von der Dunk, A., 2012. Contributions of cultural services to the ecosystem services agenda. PNAS. 109 (23), 8812-8819. https://doi.org/10.1073/pnas.1114773109.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M.A., Baste, I.B., Brauman, K.A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P.W., van Oudenhoven, A.P.E., van der Plaat, F., Schröter, M., Lavorel, S., Aumeeruddy-Thomas, Y., Bukvareva, E., Davies, K., Demissew, S., Erpul, G., Failler, P., Guerra, C.A., Hewitt, C.L., Keune, H., Lindley, S., Shirayama, Y., 2018. Assessing nature's contributions to people. Science. 359 (6373), 270-272. http://doi.org/10.1126/science.aap8826.

686 Dou, Y., Zhen, L., De Groot, R. Dua, B., Yu, X., 2017. Assessing the importance of cultural
687 ecosystem services in urban areas of Beijing municipality. Ecosystem Services. 24, 79-90.
688 https://doi.org/10.1016/j.ecoser.2017.02.011.

689 Ernstson, H., 2013. The social production of ecosystem services: A framework for studying
690 environmental justice and ecological complexity in urbanized landscapes. Landscape and Urban
691 Planning. 109 (1), 7-17. https://doi.org/10.1016/j.landurbplan.2012.10.005.

692 Fischer, A., Eastwood, A., 2016. Coproduction of ecosystem services as human–nature
693 interactions—An analytical framework. Land Use Policy. 52, 41-50.
694 https://doi.org/10.1016/j.landusepol.2015.12.004.
695
696 Flourish,studio . https://flourish.studio (Acessed 25 August 2019).
697
698 Fortnam, M., Brown, K., Chaigneau, Crona, B., Daw, T.M., Gonçalves, D., Hicks, C., Revmatas,
699 M., Sandbrook, C., Schulte-Herbruggen, B., 2019. The gendered nature of ecosystem services.
700 Ecological Economics. 159, 312-325. https://doi.org/10.1016/j.ecolecon.2018.12.018.
701
702 Gissi, E., Garramone, V., 2018. Learning on ecosystem services co-production in decision-
703 making from role-playing simulation: Comparative analysis from Southeast Europe. Ecosystem
704 Services. 34, 228-253. https://doi.org/10.1016/j.ecoser.2018.03.025.
705
706 Hudson, S.J., 2001. Challenges for Environmental Education: Issues and Ideas for the 21st
707 Century. BioScience. 51 (4), 283-288. https://doi.org/10.1641/0006-
708 3568(2001)051[0283:CFEEIA]2.0.CO;2.
709
710 Huntsinger, L., Oviedo, J.L., 2014. Ecosystem services are social–ecological services in a
711 traditional pastoral system: the case of California's Mediterranean rangelands. Ecology and
712 Society. 19 (1): 8. http://dx.doi.org/10.5751/ES-06143-190108.
713
714 Kaltenborn, B. P., Linnell, J. D. C., Gómez-Baggethun, E., Lindhjem, H., Thomassen, J., Chan,
715 K. M., 2017. Ecosystem Services and Cultural Values as Building Blocks for 'The Good life'. A
716 Case Study in the Community of Røst, Lofoten Islands, Norway. Ecological Economics. 140,
717 166-176. http://dx.doi.org/10.1016/j.ecolecon.2017.05.003.
718
719 Keesstra, S., Nunes, J., Novara, A., Finger, D., Avelar, D., Kalantari, Z., Cerdà, A., 2018. The
720 superior effect of nature based solutions in land management for enhancing ecosystem services.
721 Science of The Total Environment. 610-611 (1), 997-1009.
722 https://doi.org/10.1016/j.scitotenv.2017.08.077.
723

LiLa project, LiLa Living Lahn. https://www.lila-livinglahn.de/en/start/ (Acessed 25 August 2019).

Loft L, Mann C, Hansjürgens B., 2015. Challenges in ecosystem services governance: multi-levels, multi-actors, multi-rationalities. Ecosystem Services. 16, 150-157. https://doi.org/10.1016/j.ecoser.2015.11.002.

Loos, J., Batáry, P., Grass, I., Westphal, C., Bänsch, S., Baillod, A. B., Hass, A. L., Rosa, J., Tscharntke, T., 2019. Vulnerability of Ecosystem Services in Farmland Depends on Landscape Management. In: Schröter M., Bonn A., Klotz S., Seppelt R., Baessler C. (Eds.), Atlas of Ecosystem Services. Springer, London, pp. 91-96.

Lopes, R., Videira, N., 2017. Modelling feedback processes underpinning management of ecosystem services: The role of participatory systems mapping. Ecosystem Services, 28: 28-42. https://doi.org/10.1016/j.ecoser.2017.09.012.

Lopes, R., Videira, N., 2016. A Collaborative Approach for Scoping Ecosystem Services with Stakeholders: The Case of Arrábida Natural Park. Environmental Management. 58 (2), 323–42. https://doi.org/10.1007/s00267-016-0711-5.

Mann, C., Loft, L., Hansjürgens, B., 2015. Governance of ecosystem services: lessons learned for sustainable institutions. Ecosystem Services. 16, 275-281. http://doi.org/10.1016/j.ecoser.2015.11.003.

Opdam, P., Albert, C., Fürst, C., Grêt-Regamey, A., Kleemann, J., Parker, D., La Rosa, D., Schmidt, K., Villamor, G. B., Walz, A., 2015. Ecosystem services for connecting actors – lessons from a symposium. Change and Adaptation in Socio-Ecological Systems. 2: 1, 1-7. https://doi.org/10.1515/cass-2015-0001.

Palomo, I., Felipe-Lucia, M. R., Bennett, E. M., Martín-López, B., Pascual, U., 2016. Disentangling the Pathways and Effects of Ecosystem Service Co-Production. Advances in Ecological Research. 54, 245-283. http://dx.doi.org/10.1016/bs.aecr.2015.09.003.

Podschun, S. A., Albert, C., Costea, G., Damm. C., Dehnhardt, A., Fischer, C., Fischer, H., Foeckler, F., Gelhaus, M., Gerstner, L., Hartje, V., Haffmann, T. G., Hornung, L., Iwanowski, J., Kasperidus, H., Linnemann, K., Mehl, D., Rayanow, M., Ritz, S., Rumm, A., Sander, A., Schmidt, M., Scholz, M., Schulz-Zunkel, C., Stammel, B., Thiele, J., Venohr, M., von Haaren, C., Wildner, M., Pusch, M., 2018. RESI - Anwenderhandbuch: Ökosystemleistungen von

Flüssen und Auen erfassen und bewerten. IGB-Berichte Heft 21, 187pgs. https://dx.doi.org/10.4126/FRL01-006410777

Podschun, S.A., Thiele, J., Dehnhardt, A., Mehl, D., Hoffmann, T.G., Albert, C., von Haaren, C., Deutschmann, K., Fischer, C., Scholz, M., Costea, G., Pusch, M.T., 2008. Das Konzept der Ökosystemleistungen – eine Chance für Integratives Gewässermanagement. Hydrologie & Wasserbewirtschaftung. 62 (6), 453-468. http://doi.org/10.5675/HyWa_2018.6 _7.

Prell, C., 2011. Some basic structural characteristics of networks, in: Bodin, Ö., Prell, C. (Eds.), Social networks and natural resource management – uncovering the social fabric of environmental governance. Cambridge Universiy Press, Cambridge, p..29-43.

Prell, C., 2012. Social network analysis – history, theory & methodology. SAGE publications, London, 263 p.

Raymond, C.M., Giusti, M., Barthel, S., 2017. An embodied perspective on the co-production of cultural ecosystem services: toward embodied ecosystems. Journal of Environmental Planning and Management. 778-799. https://doi.org/10.1080/09640568.2017.1312300.

RESI-Project, River Ecosystem Service Index. https://www.resi-project.info/en/?noredirect=en_US (Acessed 6 February 2021).

Rival, L., Muradian, R., 2013. Introduction: governing the provision of ecosystem services, in: Rival, L., Muradian, R. (Eds.), Governing the provision of ecosystem services. Springer, London, pp. 1–17.

Rova, S., Pravoni, F., 2017. Analysis and management of multiple ecosystem services within a social-ecological context. Ecological Indicators. 72, 436-443. http://dx.doi.org/10.1016/j.ecolind.2016.07.050.

RP Gießens (2005).Bewirtschaftungsplan Mittelrhein. 1. Bestandsaufnahme 2004, Regierungspräsidium Gießen, Abt. Staatliches Umweltamt Wetzlar, Wetzlar.

Sattler, C., Loft, L., Mann, C., Meyer, C. (2018) Methods in ecosystem services governance analysis: an introduction. Ecosystem Services. 34, 155-168. https://doi.org/10.1016/j.ecoser.2018.11.007.

Scholz, T., Hof, A., Schmitt, T., 2018. Services Provided by Urban Trees—Novel Analysis Approaches Using Urban Tree Cadastre Data. Sustainability. 10 (3), 1-18. https://doi.org/10.3390/su10030712.

Scott, J., 1988. Social network analysis. Sociology. 22 (1), 109-127. https://doi.org/10.1177/0038038588022001007

Spangenberg, J.H., Görg, C., Truong, D.T., Tekken, V., Bustamante, J.V., Settele, J., 2014. Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies, International Journal of Biodiversity Science, Ecosystem Services & Management. 10:1, 40-53. https://doi.org/10.1080/21513732.2014.884166.

TEEB, 2010. The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Earthscan, London and Washington.

Tomscha, S.A., Gergel, S.E., Tomlinson, M.J., 2017. The spatial organization of ecosystem services in river-floodplains. Ecosphere. 8 (3), 1-18. https://doi.org/10.1002/ecs2.1728.

UK NEA (UK National Ecosystem Assessment), 2011. The UK national ecosystem assessment: synthesis of the key findings, UNEP-WCMC, Cambridge.

Umweltbundesamt, 2017. Gewässer in Deutschland: Zustand und Bewertung. Dessau-Roßlau.

Von Haaren, C., Albert, C., Barkmann, J., de Groot, R. S., Spangenberg, J. H., Schröter-Schlaack, C., Hansjürgens, B., 2014. From explanation to application: introducing a practice-oriented ecosystem services evaluation (PRESET) model adapted to the context of landscape planning and management. Landscape Ecology. 29 (8), 1335-1346. http://dx.doi.org/10.1007/s10980-014-0084-1.

Weijerman, M., Gove, J. M., Williams, J. D., Walsh, W. J., Minton, D., Polovina, J. J., 2017. Evaluating management strategies to optimise coral reef ecosystem services. Journal of Applied Ecology. 55, 1823-1833. http://doi.org/10.1111/1365-2664.13105.

Zoderer, B. M., Tasser, E., Carver, S., Tappeiner, U., 2019. Stakeholder perspectives on ecosystem service supply and ecosystem service demand bundles. Ecosystem Services. 37, 1-11. https://doi.org/10.1016/j.ecoser.2019.100938.

A. Appendices

A.1 Survey

Survey: relationships of stakeholders to the Lahn river landscape

What relationship do stakeholders have to the Lahn landscape?

Welcome page and information about the project

The Lahn river landscape is used by many stakeholders in different ways and thus also contributes to personal well-being. We would like to investigate exactly what benefits the river landscape provides and how these benefits are evaluated by different stakeholders. We are interested in the following questions:

· How do the stakeholders use the river landscape?

· How do the stakeholders evaluate certain services provided by the river landscape?

· To what extent do the stakeholders actively participate in the management of the river landscape?

We would like to invite you to participate in a short survey that highlights the above questions. We look forward to your interest and participation.

The survey is divided into three sections: benefits and relationships between people and landscape, personal information and further comments. The survey takes about 10 minutes to complete. We would like to ask you to answer each question. The survey consists of several pages. Each page allows you to review the answers you gave on the previous page. Your answers will be saved automatically. They will be treated anonymously and confidentially.

The survey is part of the PlanSmart research project funded by the Ministry of Education and Research (BMBF). PlanSmart works closely with the integrated EU-LIFE project "Living Lahn", which is developing a sustainable Lahn concept for the river. The results of the survey will be made available to the Living Lahn project as supporting information. Junior Professor Dr. Christian Albert and Dr. Barbara Schröter are responsible for the PlanSmart project. For more information on PlanSmart, please visit www.plansmart.info. For more information on the survey, please contact Ms. Camila Jericó-Daminello (daminello@umwelt.uni-hannover.de).

Thank you in advance for your interest! Your help is of great importance to us.

We will raffle three REWE vouchers worth €30 among all participants!

With kind regards.

Camila Jericó-Daminello, Barbara Schröter and Christian Albert

What importance does the Lahn river landscape have for the stakeholders?

1. Please think of the Lahn river landscape. Which landscape features are typical for you when you think of the Lahn and its surroundings?

(Please mark the three most important landscape elements)

Landscape features	
Farmland	
Urban green spaces	
Pastureland	
Industry and commerce	
Forest	
Settlement area	
Riparian vegetation (e.g., shrubs, etc.)	
Transport infrastructure	
Lakes and ponds	
Rivers and streams	

2. In principle, river landscapes can provide many services that we humans benefit from or value. From which of the following services of the Lahn do you personally profit from?

(Please select one answer for each service!)

Services	Yes	No
Provision of food		

Provision of fresh water		
Habitats for animal and plant species		
Moderation of flooding events		
Regulation of the local climate and air quality		
Reduction of (climate-damaging) greenhouse gases		
Pollination of plants by insects and other animals		
Presence of sites of historical or cultural meaning		
Presence of an attractive landscape		
Presence of opportunities for recreation and tourism		
Enabling energy from hydropower		
Enabling aquatic sports and recreational shipping		

3. So that the Lahn river landscape can provide many services, an appropriate land use and an adapted management of the landscape are partly necessary. Are you personally committed to ensuring the maintenance of these services? If yes, for which services?

(Please select one answer for each service!)

Services	Yes	No
Provision of food		
Provision of fresh water		

Habitats for animal and plant species		
Moderation of flooding events		
Regulation of the local climate and air quality		
Reduction of (climate-damaging) greenhouse gases		
Pollination of plants by insects and other animals		
Presence of sites of historical or cultural meaning		
Presence of an attractive landscape		
Presence of opportunities for recreation and tourism		
Enabling hydropower energy		
Enabling aquatic sports and recreational shipping		

4. You have indicated that you are personally committed to ensuring that certain services of the Lahn River Landscape are maintained. Do you cooperate with other stakeholders? If yes, with which groups of stakeholders do you cooperate in this regard (the categories refer to the stakeholders identified by the project "Living Lahn").

(Please select one answer for each service! You do not have to answer for your own group).

a) With which stakeholder groups do you cooperate with for the provision of food?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	

Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

b) With which stakeholder groups do you cooperate with for the provision of fresh water?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	

None of the above	

c) With which stakeholder groups do you cooperate with to provide habitats for animals and plant species?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

d) With which stakeholder groups do you cooperate with for moderation of flooding events?

Nature and Ecology	
Recreational Angling	

Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

e) With which stakeholder groups do you cooperate with to regulate the local climate and air quality?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	

Municipal Development and Land Planning	
None of the above	

f) With which stakeholder groups do you cooperate with to reduce (climate-damaging) greenhouse gases?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

g) With which stakeholder groups do you cooperate with for the pollination of plants by insects and other animals?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

h) With which stakeholder groups do you cooperate with for the presence of sites of historical or cultural meaning?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	

Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

i) With which stakeholder groups do you cooperate with for the presence of an attractive landscape?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

j) With which stakeholder groups do you cooperate with for the presence of opportunities for recreation and tourism?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

k) With which stakeholder groups do you cooperate with for enabling hydropower energy?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	

Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

l) With which stakeholder groups do you cooperate with for the enabling of aquatic sports and recreational shipping?

Nature and Ecology	
Recreational Angling	
Agriculture, Forestry and Hunting	
Water Management	
Recreational Motor Boating	
Rowing and Canoeing	
Tourism and Local Recreation	
Municipal Development and Land Planning	
None of the above	

5. How much influence do you think you have on all decisions concerning the following services?

(Please select one answer for each service!)

Please rate the degree of influence on a scale from 0 to 5, where:

0 = no influence at all

1 = very little influence

2 = little influence

3 = moderate influence

4 = large influence

5 = very large influence

Services	Degree of influence
Provision of food	
Provision of fresh water	
Habitats for animal and plant species	
Moderation of flooding events	
Regulation of the local climate and air quality	
Reduction of (climate-damaging) greenhouse gases	
Pollination of plants by insects and other animals	

Presence of sites of historical or cultural meaning	
Presence of an attractive landscape	
Presence of opportunities for recreation and tourism	
Enabling hydropower energy	
Enabling aquatic sports and recreational boating	

Personal Information

1. How old are you?

(Please choose one of the possible answers!)

a) 18 - 40 years

b) 41 - 65 years

c) over 65 years

2. Which gender do you identify as?

(Please choose one of the possible answers!)

a) Female

b) Male

c) Other

3. What is your highest educational qualification?

(Please choose one of the possible answers!)

a) No secondary school qualification

b) Secondary/elementary school diploma

c) Realschule or equivalent qualification

d) Advanced technical college entrance qualification

e) General/subject-specific higher education entrance qualification (Abitur)

f) Apprenticeship

g) Bachelor

h) Master

i) Doctoral

4. In which field do you work professionally?

(Please choose one of the possible answers!)

a) Public administration (municipalities, public authorities, administrative bodies etc.)

b) Private sector (agriculture, industry, etc.)

c) Civic sector (non-governmental organisations etc.)

d) I am already retired

e) In another sector

5. What is your postcode?

_____

6. In which working group did you participate in the interest survey for the development of the Lahn concept?

(Please choose one of the possible answers)

a) Nature and Ecology

b) Recreational Angling

c) Agriculture, Forestry and Hunting

d) Water Management

e) Recreational Motor Boating

f) Rowing and Canoeing

g) Tourism and Local Recreation

h) Municipal Development and Land Planning

Further comments

7. Do you have any other comments on this survey?

If you would like to take part in the competition for a €30 voucher from REWE, please send an e-mail with the subject "PlanSmart competition" to the following address: daminello@umwelt.uni-hannover.de

Final page

Thank you very much!

Thank you very much for participating in our survey. If you have any further questions, please contact Ms. Camila Jericó-Daminello (daminello@umwelt.uni-hannover.de).

A.2 In-degree and out-degree values

A.21.1 Food

Stakeholder groups	Indegree value	Outdegree value
Nature and Ecology	0.308	0.154
Recreational Angling	0.308	0.308
Agriculture, Forestry and Hunting	0.231	0.154
Water Management	0.231	0.462
Recreational Motor Boating	0.077	0.615
Rowing and Canoeing	0.231	0
Tourism and Recreation	0.154	0
Municipal Development and Land Planning	0.231	0
Private Business	0.154	0
Education	0	0
Other Government Agencies	0	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0	0

A.21.2 Freshwater

Stakeholder groups	Indegree value	Outdegree value
Nature and Ecology	0.308	0
Recreational Angling	0.077	0.308
Agriculture, Forestry and Hunting	0.154	0.154
Water Management	0.231	0.077
Recreational Motor Boating		0.615
Rowing and Canoeing	0.077	0.231
Tourism and Recreation	0.154	0

Municipal Development and Land Planning	0.154	0
Private Business	0	0
Education	0.077	0
Other Government Agencies	0.077	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0.077	0

A.2~~1~~.3 Habitat for Species

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.538	0.231
Recreational Angling	0.462	0.308
Agriculture, Forestry and Hunting	0.385	0.077
Water Management	0.385	0.385
Recreational Motor Boating	0.154	0.538
Rowing and Canoeing	0.231	0.308
Tourism and Recreation	0.231	0.538
Municipal Development and Land Planning	0.462	0.692
Private Business	0	0
Education	0	0
Other Government Agencies	0.154	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0.077	0

A.2~~1~~.4 Moderation of Flooding Events

Stakeholder groups	**Indegree value**	**Outdegree value**

Nature and Ecology	0.308	0.077
Recreational Angling	0.077	0.308
Agriculture, Forestry and Hunting	0.154	0.231
Water Management	0.385	0.231
Recreational Motor Boating	0.077	0.615
Rowing and Canoeing	0.154	0.077
Tourism and Recreation	0.154	0.385
Municipal Development and Land Planning	0.385	0.231
Private Business	0.154	0
Education	0	0
Other Government Agencies	0.154	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0.154	0

A.2~~1~~.5 Local Climate and Air Quality

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.308	0
Recreational Angling	0.077	0.308
Agriculture, Forestry and Hunting	0.154	0.154
Water Management	0.231	0.077
Recreational Motor Boating	0.077	0.615
Rowing and Canoeing	0.154	0
Tourism and Recreation	0.077	0.385
Municipal Development and Land Planning	0.231	0

Private Business	0.077	0
Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0	0
LiLa	0.077	0
Local Clubs and Associations	0	0

A.2~~1~~.6 Carbon Sequestration and Storage

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.385	0.154
Recreational Angling	0.154	0.308
Agriculture, Forestry and Hunting	0.154	0.077
Water Management	0.231	0
Recreational Motor Boating	0	0.615
Rowing and Canoeing	0.154	0.154
Tourism and Recreation	0.154	0.308
Municipal Development and Land Planning	0.231	0.077
Private Business	0.077	0
Education	0.077	0
Other Government Agencies	0	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0	0

A.2~~1~~.7 Pollination

Stakeholder groups	**Indegree value**	**Outdegree value**

Nature and Ecology	0.462	0.231
Recreational Angling	0.154	0.308
Agriculture, Forestry and Hunting	0.154	0.077
Water Management	0.231	0.077
Recreational Motor Boating	0	0.615
Rowing and Canoeing	0.077	0.154
Tourism and Recreation	0.154	0.077
Municipal Development and Land Planning	0.154	0
Private Business	0	0
Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0.077	0

A.2~~1~~.8 Historical and Cultural Meaning

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.308	0.077
Recreational Angling	0.077	0.231
Agriculture, Forestry and Hunting	0.077	0.154
Water Management	0.077	0.154
Recreational Motor Boating	0.077	0.462
Rowing and Canoeing	0.154	0.077
Tourism and Recreation	0.231	0.385
Municipal Development and Land Planning	0.308	0.077

Private Business	0.154	0
Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0	0
LiLa	0	0
Local Clubs and Associations	0.077	0

A.2~~1~~.9 Aesthetic Appreciation

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.462	0.231
Recreational Angling	0.154	0.308
Agriculture, Forestry and Hunting	0.231	0.308
Water Management	0.385	0.154
Recreational Motor Boating	0.077	0.692
Rowing and Canoeing	0.154	0.154
Tourism and Recreation	0.154	0.462
Municipal Development and Land Planning	0.462	0
Private Business	0	0
Education	0.077	0
Other Government Agencies	0.077	0
Family and Friends	0.077	0
LiLa	0	0
Local Clubs and Associations	0	0

A.2~~1~~.10 Recreation and Tourism

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.308	0.154

Recreational Angling	0.308	0.154
Agriculture, Forestry and Hunting	0.231	0.154
Water Management	0.231	0.308
Recreational Motor Boating	0.154	0.615
Rowing and Canoeing	0.231	0.308
Tourism and Recreation	0.308	0.538
Municipal Development and Land Planning	0.231	0.077
Private Business	0	0
Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0.077	0
LiLa	0	0
Local Clubs and Associations	0.154	0

A.2~~1~~.11 Hydropower Energy

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.154	0
Recreational Angling	0	0.308
Agriculture, Forestry and Hunting	0.077	0
Water Management	0.308	0.308
Recreational Motor Boating	0	0.308
Rowing and Canoeing	0	0.077
Tourism and Recreation	0.077	0.154
Municipal Development and Land Planning	0.154	0
Private Business	0.154	0

Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0.077	0
LiLa	0	0
Local Clubs and Associations	0.077	0

A.~~21~~.12 Aquatic Sports and Recreational Shipping

Stakeholder groups	**Indegree value**	**Outdegree value**
Nature and Ecology	0.308	0
Recreational Angling	0.154	0.538
Agriculture, Forestry and Hunting	0.154	0
Water Management	0.308	0.308
Recreational Motor Boating	0.231	0.538
Rowing and Canoeing	0.308	0.462
Tourism and Recreation	0.308	0.462
Municipal Development and Land Planning	0.308	0.077
Private Business	0	0
Education	0	0
Other Government Agencies	0.077	0
Family and Friends	0.077	0
LiLa	0	0
Local Clubs and Associations	0.154	0