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Interdisciplinary participation in climate-adapted urban land-use planning – findings of two gaming simulations in the city of Bottrop, Germany

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Abstract

Purpose – Sustainable and climate-adapted urban development requires integrative governance approaches and forms of collaboration between different disciplinary actors in urban society. Integrative approaches are a particular challenge for those planning cultures in which they are not yet sufficiently established. This also applies to formal urban land-use planning in Germany, which forms the governance setting of this study. This study aims to examine how interdisciplinary participation in formal urban land-use planning contributes to the consideration of climate adaptation in the planning process.

Design/methodology/approach – This paper traces the process of two differently designed interdisciplinary participation formats based on the methodological framework of a gaming simulation, each in the context of a formal urban land-use planning procedure in Bottrop, Germany. The gaming simulations are designed as performance simulations in which we involved several representatives from different public authorities.

Findings – The gaming simulations show that interdisciplinary participation can lead to an increased awareness of climate adaptation requirements in particular and a mutual understanding of different logics of action in the context of comprehensive and sustainable urban planning in general. In addition, this paper provides recommendations as to how and under what conditions the benefits of the simulations can be transferred to municipal practice.

Originality/value – While integrative and interdisciplinary formats are increasingly being used in the context of informal urban planning, this does not apply to formal urban land-use planning. Participation in

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formal urban land-use planning procedures is classically linear and multidisciplinary in Germany. Using two simulated interdisciplinary participation formats, this paper tested to what extent the consideration of climate adaptation requirements as a cross-sectoral task can benefit from interdisciplinarity in the context of two formal urban land-use planning procedures.

Keywords Climate adaptation, Interdisciplinarity, Gaming simulation, Public participation, Social learning, Urban land-use planning

Paper type Research paper

1. Introduction

In many cities around the world, efforts to achieve sustainable and climate-resilient urban development are high on the agenda. Many urban researchers, local planners and decision-makers recognise the fundamental need for action on climate mitigation and adaptation. However, the latest reports of the Intergovernmental Panel on Climate Change (IPCC) (2022a, 2022b) remind us that consistent implementation is slow. The tasks of climate mitigation and adaptation are challenging in several ways: they are cross-sectoral, complex and in many places compete with other interests in urban society. Such overarching challenges require integrative governance approaches and forms of cooperation between different disciplinary stakeholders in urban society. The popular slogan to "break down the silos" in debates on sustainability and climate change governance includes the demand for policy integration and coherence as a requirement for an interdisciplinary, holistic and systemic approach in planning projects (Meuleman, 2021).

Interdisciplinarity is not a new issue in urban research and practice in general. For many years, successful research and experimentation have been conducted on inter- and transdisciplinary methods and tools developed in the context of informal urban development (see e.g. Sieber *et al.*, 2022; Huning *et al.*, 2021; Räuchle, 2021; Fuchs *et al.*, 2020). But there are hardly any studies dealing with the testing of interdisciplinary approaches in formal urban land-use planning so far. Given the positive findings as a fruitful approach in the informal planning context, a logical assumption seems to be that interdisciplinary approaches could also contribute to solve governance issues, such as the better implementation of cross-sectoral climate adaptation in formal land-use planning.

Integrative approaches in formal land-use planning are a particular challenge for those planning cultures in which they are not yet sufficiently established. This applies, among others, to the governance system in Germany and its formal urban land-use planning. In contrast to consensus cultures (e.g. The Netherlands, Denmark) or public interest models of governance (e.g. Australia, New Zealand, the UK), opening up silos through interdisciplinary approaches has proven more difficult in constitutional cultures such as Germany and hierarchical cultures in general (Meuleman, 2021).

For consistent climate adaptation in German formal land-use planning, the difficulties in connecting silos are particularly reflected in the weighing and weighting of different concerns and interests. Planners involve public authorities and agencies through written comments that are included in the weighing process [see Section 3 of the German Federal Building Code (BauGB)]. The BauGB prescribes these written comments but does not provide any further details on the design of the participation process itself. The problem with conventional participation and weighing processes is that there is no, or only recently has been a specialist group in the municipal administrations dedicated specifically to climate concerns. Although Germany adopted a framework law on climate adaptation in November 2023, there are no sectoral laws on different climate impacts that prescribe specific regulations for planning procedures, as there are, for example, for noise and air pollution

control. Therefore, the municipalities have a significant range for consideration and weighing, which they still too rarely use in favour of climate adaptation. Thus, silo structures of the municipal administrations and a lack of interdepartmental awareness of climate issues are two of the main obstacles to consistent adaptation to climate change.

This study addresses the challenges of implementing climate adaptation due to silo structures by testing social learning approaches triggered by interdisciplinary interactions. Such interactions have the potential to contribute to a higher awareness of climate issues and climate adaptive capacity of those involved in planning. By conducting two gaming simulations of interdisciplinary participation in urban land-use planning, this study provides answers to the questions of (1) how interdisciplinary participation formats can contribute to climate-adapted or "better" urban land-use planning and (2) how such interdisciplinary participation processes can be designed in a practical way to exploit the potential contribution of interdisciplinary cooperation. We designed both gaming simulations as performance simulations (see Kriz and Hense, 2006) and carried them out together with the city administration in Bottrop, Germany, at the example of two planning procedures for the development of a climate-adapted commercial area (two case studies).

In the following chapter, we give a brief insight into the city where we conducted the two case studies and our methodological approach. Then, we present detailed information on the municipal governance setting in German municipalities and the concepts of silo thinking and interdisciplinarity. Thereafter, we describe our empirical results, which we discuss afterwards to present our recommendations and conclusions at the end.

2. Case study area, material and methods

The case studies are located in the city of Bottrop, Germany (see Figure 1). Bottrop is a major and county-free city with a population of around 117,000. The city is located in Western Germany in the Ruhr area, Germany's largest agglomeration. As in all other German municipalities, the municipal administration of Bottrop is organisationally divided into specialised departments, each consisting of different disciplinary offices. A special feature of Bottrop's administration is the *Integrated Urban Development/InnovationCity coordination office*, whose core task is climate-friendly urban redevelopment. This office emerged from the large-scale *Innovation City* model programme that the municipality of Bottrop has been pursuing since 2010.

Historically, particularly the Southern part of Bottrop is more densely populated and bioclimatically heavily burdened due to high sealing, heat-emitting sources and a lack of greenery or connection to green spaces. Bottrop already suffers significantly from the consequences of climate change. Forecasts for the increase in hot days suggest that the situation in the already heavily burdened climate zones will further deteriorate (RVR, 2019). In addition to heat stress, Bottrop is regularly affected by heavy rainfall and storms that cause considerable damage, as seen in the consequences of the summer storm in June 2014 and the heavy rainfall event in July 2021.

In this governance setting, we simulated and tested two interdisciplinary participation formats in two urban land-use planning processes. We based both participation formats on the methodological framework of a gaming simulation (see e.g. Meier and Duke, 1966; Diekmann and Leppert, 1978) in the form of a performance simulation (Kriz and Hense, 2006). To increase the significance of the research results, we designed the performance simulation in a mostly closed and rather simple way. In the performance simulations, we involved administrative employees from several departments. All participants remained in their own roles to be able to contribute their expertise in the best possible way. The overarching objective of both formats was to develop measures for commercial areas

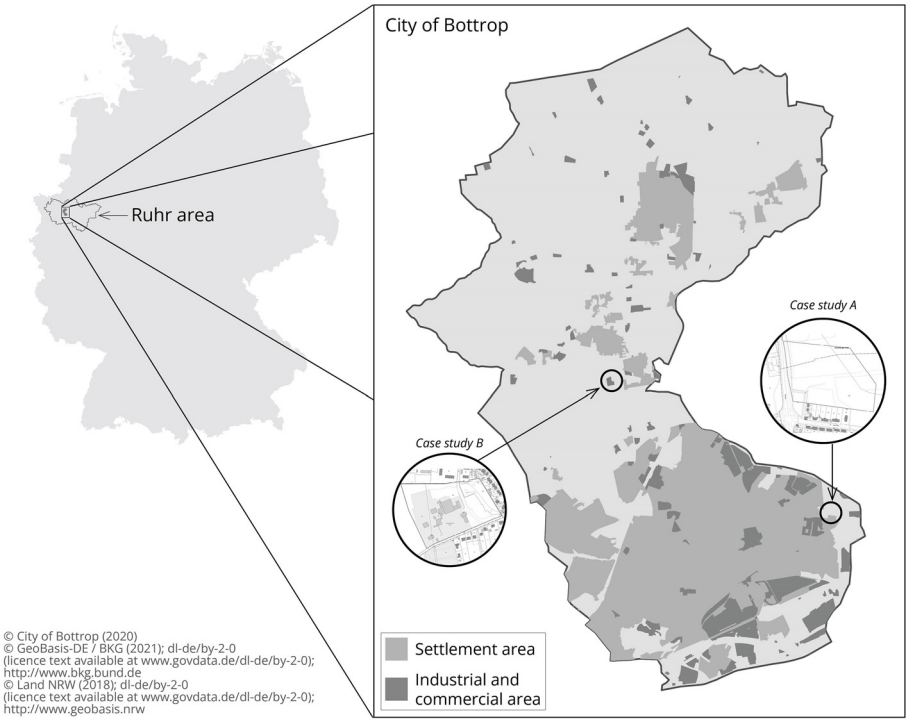

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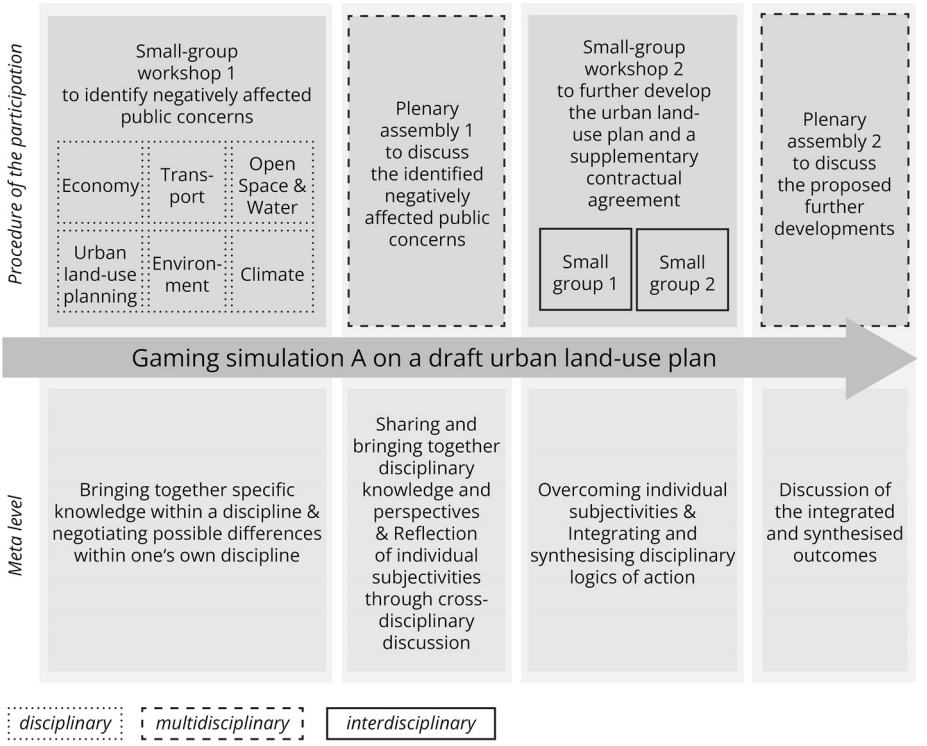
Figure 1. Location of the case study areas

adapted to climate change. The subject of discussion in each format was a draft urban land-use plan of a climate-adapted commercial area and supplementary contractual agreements. The participants had the task to identify public concerns negatively affected by the draft plan and to validate and further develop climate adaptation measures proposed therein.

We designed the two gaming simulations with disciplinary, multidisciplinary and interdisciplinary elements to varying degrees (see Figures 2 and 3). This served to explore different levels of benefits and practicality. We designed the gaming simulation A in a way that the identification of negatively affected issues remains in the disciplinary cooperation. The validation of the draft plan and its further development took place through interdisciplinary groups. In this gaming simulation, we met with 23 administrative employees from the disciplines economy, transport, environment, civil engineering and urban development (online due to the Covid 19 pandemic). Interdisciplinary elements like discussions in a plenary assembly and small-group workshops served to break down silo structures and silo thinking. Thus, the participants had the opportunity to exchange ideas, ask questions and get a better understanding of challenges with climate adaptation faced by other authorities. In comparison, we designed the gaming simulation B to be less interdisciplinary and more multidisciplinary. Its design is more similar to the usual participatory approach of the city administration. The departments involved drafted their written comments but without a subsequent interdisciplinary exchange and further development of the draft urban land-use plan. Thus, this gaming simulation differs from the



Source: Authors' own illustration

Figure 2. Concept of the gaming simulation A

traditional approach in that it includes (at least) a joint discussion within the disciplines. We recorded and evaluated both gaming simulations using a standardised survey ($n_A = 10$, $n_B = 7$).

3. Theory

In the context of developing climate-adapted commercial areas, this study addresses, on the one hand, obstacles posed by silo structures anchored in municipal administration and formal urban land-use planning and, on the other hand, possible solutions through interdisciplinary participation. In the following, we describe the German urban land-use planning as well as the concepts of silo structures and interdisciplinarity to enable the classification of our empirical results.

3.1 Urban land-use planning in Germany

In Germany, the municipal administration, together with the municipal council, is obliged under the Building Code to prepare and control urban development and the use of land for construction or other purposes through urban land-use planning (Pahl-Weber and Henckel,

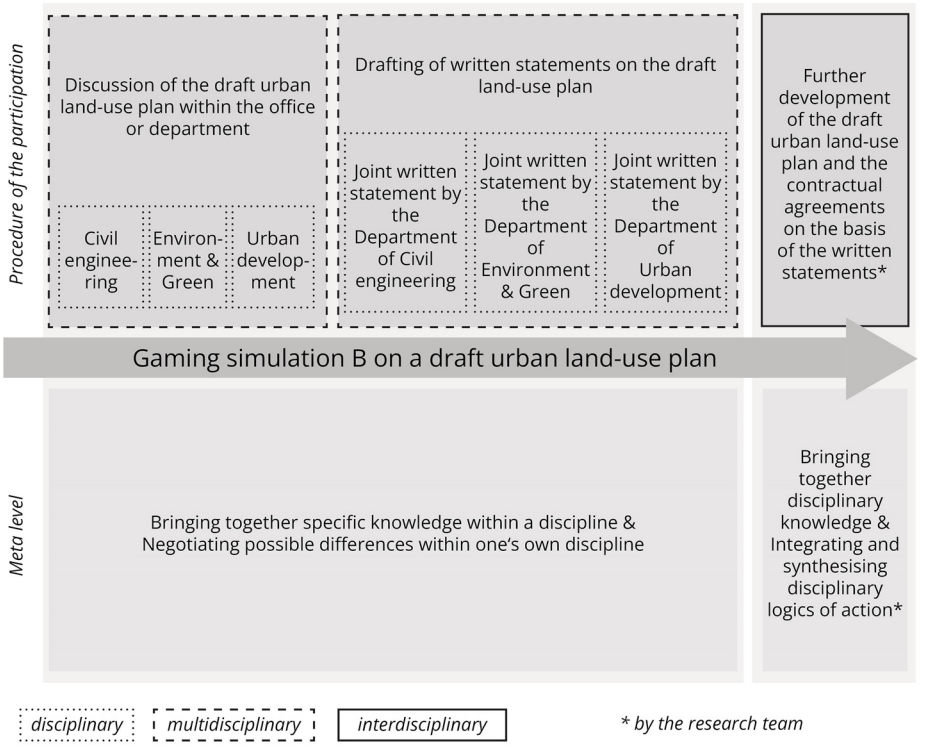


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Figure 3. Concept of the gaming simulation B

2008). Urban land-use planning is a formal tool in Germany. According to Section 1 (5) of the BauGB, this tool is intended:

- to ensure sustainable urban development and a socially equitable land-use that serves the public good; and
- to contribute to human environment and to the protection and development of natural resources as well as the preservation and development of the urban cultural heritage.

Planners must duly weigh public and private interests affected by urban land-use planning [Section 1 (7) of the BauGB]. To support this weighing process, the law stipulates the participation of public authorities and other public agencies through written comments [Section 4 of the BauGB]. Public authorities and agencies include, among others, departments, local authorities and environmental associations on local and regional level. Public authorities and agencies, neighbouring municipalities and individuals can participate in regular planning processes at least twice by law as part of an early and a formal participation [see Section 3 (1) and (2) and Section 4 (1) and (2) of the BauGB; see Figure 4]. They shall deliver their comments and opinions within 30 days. These comments are to be

German Federal Building Code	*Steps as part of the formal urban land-use planning process*	*Information and Participation*
Section 2 (1)	Publishing the plan preparation decision in the manner customary in the municipality	
	Developing of a preliminary planning concept by the municipality	
Section 3 (1) Section 4 (1)	Informing the public and public authorities and agencies about the general aims and purposes of planning & Possibility to supply comments	Early participation (stage 1): Possibility of participation by law
	Developing a draft urban land-use plan by the municipality based on collected comments	
Section 3 (2) Section 4 (2)	Public participation and participation by public authorities and agencies; Opportunity to supply comments within 30 days	Formal participation (stage 2): Participation by law
Section 1 (7)	Duly weighing of public and private interests affected by urban land-use planning & Revising the draft plan by the municipality	
Section 10 (1)	Adopting the binding land-use plan as a bye-law or municipal statute by municipal council	

Source: Authors' own illustration

Figure 4. Participation in regular planning processes

explicitly limited to their remit. If the plan is changed majorly, formal public participation and participation by public agencies need to be done again.

Thus, urban land-use planning processes are classically linear, in which the various sectoral planning are processed one after another, and generally do not offer integrality (Messerschmidt and Zadow, 2018). However, the law does not regulate the procedural design of the participation process and offers the municipality scope of action.

The conventional participation process (see Figure 5) in urban land-use planning processes reflects the general disciplinary structure of municipal administrations (Pahl-Weber and Henckel, 2008). The disciplinary structure of municipal administrations and land-use planning can lead to considerable obstacles to the effective integration of social, economic and ecological dimensions of sustainable development as well as climate change aspects in planning processes (Galderisi and Limongi, 2017). In this context, researchers and practitioners often discuss the concept of silo structure or silo thinking.

3.2 Silo structures

Meuleman (2021, 5914/17) generally describes a silo as "an isolated grouping, department, etc. that functions apart from others" (see also Bento *et al.*, 2020). He distinguishes between three types of silos: political, institutional and mental silos (Meuleman, 2021). Political silos

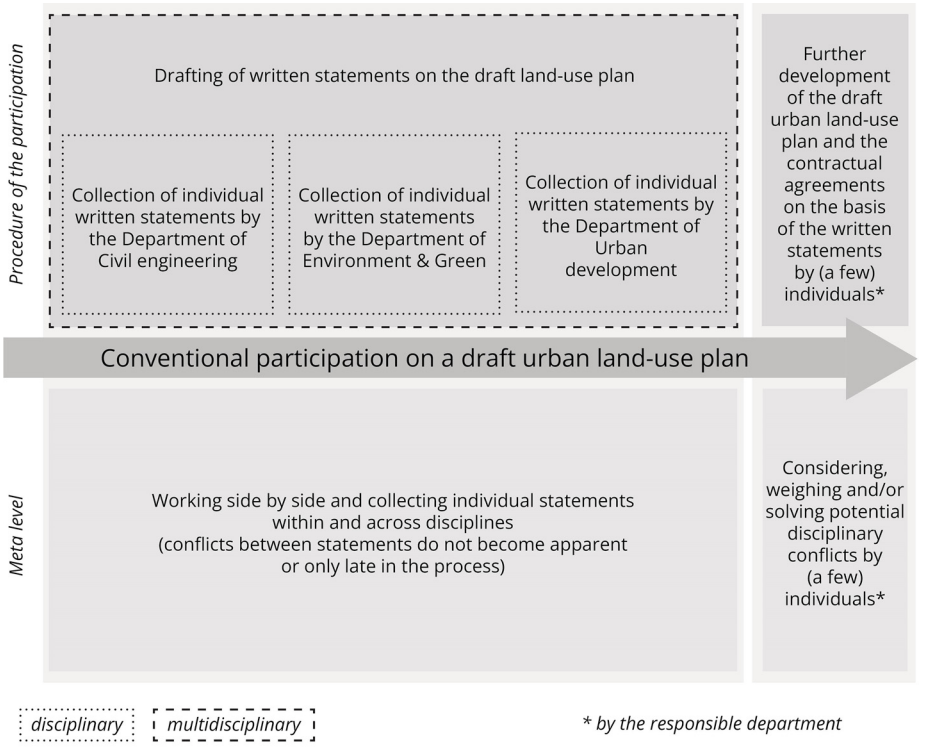

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Figure 5. Concept of the convention participation process

describe the focus of politicians and decision-makers on individual policy areas to raise their profile and thus win political majorities in a democratic context. Institutional silos are the way public administrations organise themselves to divide complex issues into partial problems that are handled by separate sectoral or functional units. Silos mentalities are often linked to political and institutional silos and apply to people who are convinced that their perspective is the best or only logic of action for cultural, political, power, career, cognitive or other reasons.

All types of silos are associated with advantages and disadvantages (see Table 1). In this study, we focus on institutional and mental silos. In municipal administrations, institutional silos provide focus and structure to working tasks; accordingly, they lead to concentration of expertise as well as greater transparency and accountability from an organisational perspective (Meuleman, 2021). They provide clear and reliable contact points for stakeholders inside and outside the administration, without which networking and partnership building are difficult (Meuleman, 2021). Thus, a siloed administration *per se* does not prevent the collaboration with others, as it is often assumed (Meuleman, 2021). However, institutional silos can become an obstacle when certain tasks – such as climate adaptation in this study – do not fit into a particular silo or are cross-disciplinary (Albrecht,

Table 1. Benefits and challenges of silos

Type of silo	Challenges	Benefits
Institutional silos	Lack of trust between silos; contacts/ communication between silos may be prohibited or must go through hierarchy	Provision of structure, focus, protection against other departments, clarity, responsibility, transparency, accountability
Mental silos	Lack of common goals, joint responsibility and interest in other colleagues' areas; not taking responsibility beyond one's own job description	Provision of identification, a "safe" work environment, a "home base" protected from external interventions

Source: Authors' own table according to Meuleman (2021)

2002). In such cases, individual silos often neglect these tasks because they feel responsible for their own parts of the project, but not for the overall task or outcome (Albrecht, 2002). Therefore, silo effects of institutional silos can become a threat, especially in highly complex tasks due to limitations in interdependence (Bento *et al.*, 2020). In addition, silo mentalities are seen as another major cause of ineffective cross-departmental collaboration (Meuleman, 2021). These mentalities are often equated – sometimes perhaps incorrectly – with a lack of systems thinking and vision for the organisation as a whole. This can lead to lower efficiency within the administration (Bento *et al.*, 2020). Furthermore, institutional and mental silos generally show tendencies towards inertia or resistance to change (Barry *et al.*, 2008; Meuleman, 2021).

However, we would like to point out that silos or disciplines themselves cannot be considered completely homogeneous or closed. Instead, they are themselves often heterogeneous entities characterised by differences that are negotiated (Bensaude-Vincent and Stengers, 1996; Galison and Stump, 1996; Laclau and Mouffe, 2001).

3.3 Social learning and interdisciplinary approaches

Given the challenges posed by silo structures, approaches of interdisciplinarity (see Table 2) seem to be suitable approaches to solutions, especially for cross-sectoral tasks such as climate-adapted settlement development. Interdisciplinary approaches are designed to dissolve disciplinary rules and set aside individual subjectivities based on disciplinary training and knowledge bases (Barry *et al.*, 2008). They offer the possibility of bringing together disciplinary knowledge and logics of action (Barry *et al.*, 2008). In theory, this can enable sufficient system and action knowledge to develop and evaluate suitable measures in urban land-use planning. Unlike interdisciplinarity, multidisciplinarity seeks cooperation among several disciplines, but each remains unchanged and works with the usual disciplinary framings. Transdisciplinarity, on the other hand, aims to merge disciplines and create new approaches by overcoming the distance between research, politics and society. Within the regulatory framework of formal urban land-use planning, an interdisciplinary approach is therefore best suited to promote the integration of a cross-cutting issue such as climate adaptation.

The concept of interdisciplinarity can also be embedded in the concept of social learning. Social learning is increasingly becoming a normative goal associated with shifts towards adaptive management and the involvement of stakeholders as a means of coping with complexity and the resulting uncertainty (Holling, 1978; Reed *et al.*, 2010; Walters, 1986; Walters and Holling, 1990). The underlying assumption is that stakeholders can learn

Table 2. Differences between multidisciplinarity, interdisciplinarity, and transdisciplinarity

Multidisciplinarity	Interdisciplinarity	Transdisciplinarity
The collaboration of several disciplines, each remaining unchanged and working with the usual disciplinary framings	The integration or synthesis of perspectives from several disciplines	The transgression or transcendence of disciplinary norms, whether in pursuit of a fusion of disciplines, an approach oriented towards complexity or real-world problem solving or an approach to overcoming the distance between professional and lay knowledge or between research and politics or society

These approaches each reflect a spectrum. For example, in its weakest form, interdisciplinarity can be little more than cooperation, and in its strongest form, it can be a basis for transformative reconfiguration of disciplines

Source: Authors' own table based on Barry *et al.* (2008); Lawrence and Després (2004); Petts *et al.* (2008)

through their participation in decision-making processes and thereby improve their adaptive capacity (Fazey *et al.*, 2007; Folke *et al.*, 2005). We already know from previous studies that participatory formats in (sectoral) planning processes facilitated social learning by increasing the levels of skills in collaborating with other actors and knowledge on climate change impacts in particular (see e.g. Albert *et al.*, 2012; Keen *et al.*, 2005). In general, social learning means firstly the significant change in the understanding of individuals in the form of new or more detailed information, changed attitudes, world views or beliefs, and secondly the changes through social interaction and processes in a larger network and context beyond the individual (Reed *et al.*, 2010).

4. Results

The gaming simulations revealed a variety of findings on benefits and weaknesses, which the participants attributed to the different elements of intra-disciplinary, multidisciplinary and interdisciplinary cooperation. Regarding the design of the cooperation, there are similarities and notable differences in the evaluations of the two gaming simulations. We integrated an intra-disciplinary exchange element in both gaming simulations, albeit to a different extent. In this regard, participants emphasised the benefit of being able to bring together heterogeneous intra-disciplinary knowledge. The participants perceived this as an added value compared to conventional approaches, as conflicts and contradictory recommendations can arise within a discipline when drafting written comments without further intra-disciplinary exchange. In reality, such intra-disciplinary disagreements usually have to be revised again, which is time-consuming.

The decisive factor for the differences in the evaluations of both gaming simulations is the composition of the participants in the working groups when further developing the draft land-use plan (intra- or interdisciplinary) and, more specifically, the involvement of the participants in the integration and synthesis work. In contrast to gaming simulation B, gaming simulation A included interdisciplinary working groups that further developed the draft urban land-use plan. This form of collaboration encouraged creative thinking among participants regarding more innovative, new measures, especially for climate adaptation (one participant emphasised the significantly higher level of creativity in thinking compared to the more multidisciplinary gaming simulation B). The ideas of participants from other

disciplines functioned as inspiration. For the first time in an urban land-use planning process, the gaming simulation A enabled the joint interdisciplinary elaboration of possible climate adaptation measures. This also meant that, for the first time, participants had the opportunity to discuss measures beyond their own discipline and to exchange directly with other departments about the suitability of proposed measures at the interfaces between disciplines. Together, they were able to approve or reject some of the proposed measures relatively quickly. An example: the participants of gaming simulation A intensively discussed the weighing of building density and the degree of impervious surface as key control factors with regard to climate adaptation. This required special attention and a willingness to compromise. Through interdisciplinary dialogue, the participants agreed on the determination of a maximum cubic index [Section 16 (2) (2) of the Federal Building Use Ordinance] instead of an usual maximum site occupancy index in combination with a maximum building height. From the point of view of climate adaptation, determining a maximum cubic index regulates the building volume and thus the radiant heat and ventilation, while at the same time giving land developers a great deal of flexibility in building design. One challenge, however, is calculating the degree of impervious surface and thus the necessary rainwater retention volume in advance. As the city is the landowner of the case study area, the participants decided to address this challenge through individual contractual agreements as soon as the plans for developing the site become more concrete. In the event of extremely heavy rainfall, the interdisciplinarily developed land-use plan provides public traffic areas with water drainage routes [Section 9 (1) (11) of the BauGB] along neuralgic roads and public green spaces for rainwater retention [Section 9 (1) (16) of the BauGB].

The interdisciplinary exchange also promoted understanding for other interests and learning effects among the participants. In the gaming simulation B, the participants were not involved in the integration and synthesis work due to the multidisciplinary structure (in this case, the research team did it). It remained unclear to the participants whether certain suggestions would be taken up or could not be implemented due to other requirements of other disciplines. They could only “hope” that their concerns from their written comments would be adequately considered in the revision process of the draft urban land-use plan. Immediate negotiation processes, justifications, and arguments are missing here. Potential effects of social learning are not realised. This also applies for real participation in urban land-use planning processes. In comparison, the participants stated learning effects in the course of the gaming simulation A with its interdisciplinary exchange (including argumentations) and involvement in the integration and synthesis performance. Many participants gained both a better understanding of the logics of action and interests of other departments as well as insights for improvements within their own area of responsibility.

Despite the feedback on the benefits of interdisciplinary further development of urban land-use plans, weaknesses also emerged. In general, the participants assessed the exchange in the large group as time-consuming, as the exchange would not have replaced the prescribed written comment in the participation process. In addition, the level of detail of the participants’ contributions in the gaming simulation B was significantly higher compared to gaming simulation A.

Although weaknesses emerged, the participants explicitly described the interdisciplinary exchange in the larger group as profitable, not only to raise awareness for other disciplines and climate issues in particular but also regarding the quality of the urban land-use plans. Therefore, they referred to such participation processes, i.e. the exchange and linking of disciplines, as a good practice for future urban land-use planning processes, especially for complex ones, to develop areas in the best possible way. As a result of the gaming

simulations, the intra-disciplinary exchange to write a written comment has been adopted in urban land-use planning practice.

5. Discussion

Our study results join the still very small series of similar studies on planning procedures that show positive effects on social learning based on different forms of collaboration, especially in the field of climate change, even if the respective areas of investigation differ (see e.g. Albert *et al.*, 2012; Schusler *et al.*, 2003; McCrum *et al.*, 2009; Keen *et al.*, 2005). From the empirical findings, we learn that interdisciplinary participation promotes more creative and innovative urban development measures, as the example of the "uncommon" determination of the maximum cubic index described before demonstrates. The originality of ideas and approaches is primarily determined by the extent to which they are already known and established in a particular context or among a particular group of participants (see e.g. Defila and Di Giulio, 2018 on the evaluation of innovative methods in transdisciplinary collaborations). Following this understanding, it can be assumed that innovative ideas are increasingly initiated or contributed by participants from other disciplines, who are not familiar with traditional or established procedures and logics of action. They are more able to think unconventionally and beyond boundaries, thus coming up with other possibly innovative solutions. By testing and possibly proving innovative solutions, interdisciplinary exchange and elaborations not only hold the potential to question disciplinary norms and rules but even to expand, change or reform them within disciplines.

Nevertheless, when reflecting these findings, it should also be taken into account that the potential for producing more innovative climate adaptation approaches could not be completely separated from the non-binding nature of the gaming simulations. This non-binding character may have contributed to many participants discussing "unconventional" adaptation measures for their discipline, especially in the phase of interdisciplinary development of the draft urban land-use plan. Moreover, the game character can lead to external factors, constraints and interests (e.g. from politics or economics) being initially neglected in the simulation but cannot be disregarded in reality. In reality, planners often neglect considerations or requirements from a climate perspective due to political and cost pressures. However, the participants perceived both gaming simulations as unique opportunities to be uninfluenced by the "real" challenges of planning and to give their ideas and thoughts more space than in everyday work. Despite this, the learning benefit from new inspiration provided by the non-binding gaming simulations remain applicable to real procedures and can be further developed in actual planning processes.

Another essential benefit we draw from our empirical results is the potential for raising awareness for other disciplinary interests and logics of action in general and climate adaptation needs in particular. This effects of social learning were also confirmed in a similar study by Albert *et al.* (2012). Raising awareness was particularly high among participants who have so far been less concerned with climate adaptation issues. This can lead to breaking down mental silos on the one hand and effects of social learning on the other hand. Overall, the resulting urban land-use plans of our gaming simulations provide much more comprehensive regulations that serve to prevent impacts of heat and heavy rainfall (e.g. regarding land use, building orientation and design) than other common land-use plans in Bottrop.

However, the effects of social learning achieved are partly a crux: the benefits are person-related. With a change of staff, planning can no longer benefit from the effects of social learning that is generated step by step with each interdisciplinary exchange. However, it

cannot be assumed that a significant group of regularly involved staff will change at the same time.

Nevertheless, the results of this study can only be generalised to a limited extent, as individual factors can influence the outcomes. For example, they depend on the participants and their general experience and awareness about climate change. Particularly, the awareness of planning authorities in Bottrop for climate adaptation was probably already at a higher level, as indicated by Bottrop's *Integrated Urban Development/InnovationCity coordination office*. Many authorities, especially in smaller cities or rural municipalities, often lack the personnel and financial resources to gain expertise on the multitude of planning issues. Accordingly, results may vary depending on the size of the city.

The study applied a qualitative research approach and analysed two gaming simulations. Due to the small sample size, the validity of the results is limited. Further case studies or quantitative studies should be carried out to see whether similar results can be achieved. The difficulty, however, lies in the standardisation of complex and integrative planning issues like climate change adaptation. Of course, there are advantages of quantitative studies, but significant scientific knowledge can also be gained directly from authorities. The adoption of some elements of the gaming simulations into regular planning practice in Bottrop confirms the quality and relevance of the results of this qualitative study.

6. Recommendations on how to design the interdisciplinary participation to be practical

The case studies as well as experiences in practice give hints on how to design interdisciplinary participation.

6.1 Group of participants and available personnel resources

One major point is to choose the group of participants wisely. Participants need to be well prepared and of course, they need to be decision-makers. This ensures high-quality and concrete comments on the draft. Experience shows that in large groups there is a high risk of silent listeners who often do not or cannot contribute to the discussion. Therefore, we recommend a group that is sufficiently large and as small as possible, with well-prepared participants. To ensure adequate representation of climate adaptation requirements, planners should at least involve one participant with such expertise. Reducing the overall number of participants contrasts with the current trend that planners involve more and more stakeholders. The reasons for that lie in the increasing planning complexity in general and the increasing lack of clarity about which stakeholders should be involved to avoid jeopardising the participation process from a legal point of view. Unfortunately, planners and planning authorities often do not know which specific public bodies need to be involved in the first place. Therefore, the common practice is to contact all known public agencies hoping that all relevant authorities have been reached. Many public authorities and agencies have limited time and staff resources. This is also a consequence of the numerous requests for participation described before. Reducing the group size of the participants to an essential/required level can also help in this regard.

In addition, we advise limiting the exchange in terms of time. To do so, the planners should have already worked out the main key points on which they need feedback. In addition, public authorities and agencies can make further comments. Some sectoral planning authorities already hand out a checklist of information they need to make substantial comments and opinions. We recommend implementing it into planning processes and interdisciplinary participation as well.

Furthermore, it can be beneficial to arrange an online meeting instead of a face-to-face meeting because it ties up less time and thus financial resources. It is also easier to find a shared time slot in which the exchange can take place. Nevertheless, planners should bear in mind that with an online meeting there is a higher probability that individual participants will devote themselves to other work tasks in parallel and no longer participate in the online meeting in a concentrated manner.

However, to save resources of planners and participating authorities and agencies, a comprehensive interdisciplinary exchange is not necessary in all cases. Some land-use plans cover only small areas or aim to change only minor legally binding measures in already existing residential or industrial areas. In these cases, the cost-benefit ratio of extensive exchange may not be appropriate for the planning process. Whether an exchange is necessary or not should be decided by the responsible planners.

6.2 Benefits of interdisciplinary participation at different points in the process

The benefits generated also depends on what stage in the planning process planners initiate interdisciplinary exchanges. Speaking from experience in land-use planning processes, it is best to integrate interdisciplinary exchange in the beginning of legal planning processes. At this stage, the basic planning intentions are already set, but the planners have not fully developed the plan yet. It also makes sense to consider aspects of climate adaptation from the outset to negotiate them at an early stage in an interdisciplinary exchange with other disciplines. As part of early participation (see Figure 4) or even earlier, public authorities and agencies have a major influence on measures in draft urban land-use plans. In the later course of planning processes, planners hardly make any major changes to prevent repeating the legal process of formal public participation. Of course, municipalities are interested in speeding up planning processes. On the one hand, they want to achieve planning goals quickly to meet the needs of the citizens. On the other hand, prolonging planning processes tie up financial and human resources, which causes higher planning costs and therefore higher property prices.

Interdisciplinary exchanges can take place even before the legal planning process has started. Planners usually base land-use plans on preliminary informal urban planning concepts, which, at best, already consider climate adaptation. This includes, for example, the position of the buildings to keep air corridors free, natural infiltration of precipitation, green roofs, supply with renewable energies and comparable measures. However, at this point, such concepts are mostly vague, as expert opinions about soil, energy supply, water management etc. are missing.

To sum it up, the goal of the exchange depends on the planning stage in which interdisciplinary exchanges take place. It can be either collecting information to develop an urban concept idea or discussing or further developing an already existing draft of a legal land-use plan. We also recommend adding climate adaptation explicitly as a separate planning goal to raise awareness of the importance of climate adaptation among stakeholders.

6.3 Quality and level of detail of the participants' contributions

Partly dependent on the design of interdisciplinary participation, planners must pay attention to the quality and complexity of the participants' contributions when preparing the interdisciplinary participation from three points of view. Firstly, it requires a more intensive preparation of the participants, since the interdisciplinary participation appointment is limited in time and allows fewer opportunities for spontaneous research. In contrast, the preparation of the written comments is more flexible and independent in terms of time. The authorities and agencies involved can interrupt the writing at any time as needed for further

research. Insufficient preparation of the participants for an interdisciplinary participation can lead to a lower quality of contributions and objections. Secondly, the limited time also means that the participants cannot discuss all (sectoral) objections in the greatest detail. The more intensively such objections are discussed, the less time is left for other discussion points. However, this may be less relevant for crosscutting tasks such as climate adaptation of settlement structures. Thirdly, the level of detail of the contributions in a participation appointment tends to decrease to a certain extent with an increasingly interdisciplinary group of participants. In this context, the experts often tend to simplify content to involve the completely interdisciplinary group of participants, considering different expertise and backgrounds to consequently facilitate a joint discussion (see e.g. concepts of *didactic transformation* or *didactic reduction*). In contrast, the conventional written comment focuses on sectoral objections and recommendations, so that the sectoral experts provide a deep level of detail.

However, we recommend a professional moderator or mediator with appropriate communication skills. In some respects, interdisciplinarily trained planners would be suitable for this. The moderator can settle disputes as well as structure the discussion and mediate between the disciplines if necessary. The latter is also the reason why planners with interdisciplinary training are particularly suitable for this.

6.4 Interdisciplinary participation against the background of legal requirements

Despite the described benefits and weaknesses of an interdisciplinary participation of authorities and agencies in urban land-use planning, the fact remains that the Federal Building Code or the decision of the German Federal Administrative Court prescribes a written comment or a comment declared for recording for participation. The purpose is that the comments are available in a form that documents them permanently and by which they can easily be referred to during the process. This serves firstly the security of the planning municipality which wants to avoid a procedural error, and secondly the security of the participating authority or agency that its comment can be properly examined and taken into account. The striving for documentation of all procedures on file goes back to Max Weber's (1922) model of bureaucracy, which has shaped German public administration, including local government, for over 100 years.

To guarantee planning security and to go hand in hand with the formal requirements of participation processes, it needs a (detailed) record of the interdisciplinary participation. By its subsequent official agreement by the participants, this record can function as an adequate alternative to a written comment. This does not preclude individual participating authorities and agencies from submitting an additional written comment. It would also allow stakeholders to submit their comments who may not have participated in the interdisciplinary exchange due to the recommended smaller number of participants and may have a different opinion on the draft urban land-use plan.

7. Conclusions and outlook

Based on our study, we see a considerable benefit of interdisciplinary participation with regard to the implementation of climate adaptation requirements in particular and the quality of urban land-use planning in general. Messerschmidt and Zadow (2018) already emphasised the influence of the organisation and the process of planning on the quality of the planning result. In practice, opportunities must be created for this, e.g. – as tested in this study – by planners during participation processes in urban land-use planning that are necessary anyway.

The main challenge is in the practicable implementation of interdisciplinary participation in urban land-use planning; this concerns in particular resource issues – both for the planners and participating authorities and agencies. We suggest benefiting from interdisciplinary

cooperation on a case-by-case basis, especially in complex land-use planning processes. We are not arguing for mandatory interdisciplinary participation or even the abolition of institutional silos. Rather, it is about opening and connecting any mental silos, e.g. through the effects of social learning, which can be promoted through interdisciplinary approaches.

From our point of view, the gaming simulations were able to make a good contribution to connecting mental silos through raising awareness and mutual understanding for climate adaptation in particular and different interests and logics of action in general. Given the few previous studies of social learning effects of interdisciplinary planning processes, our findings provide an essential contribution to the research field. However, it needs further research on this. The gaming simulations were based on a fictitious planning project, so that planners and participants may react differently than in reality. It requires scientifically supported test runs for real participatory processes. In addition, we see a need for further research regarding the sustainability of possible generated benefits and social learning effects.

References

Albert, C., Zimmermann, T., Knieling, J. and Haaren, C. V (2012), "Social learning can benefit decision-making in landscape planning: gartow case study on climate change adaptation, elbe valley biosphere reserve", *Landscape and Urban Planning*, Vol. 105 No. 4, pp. 347-360, doi: 10.1016/j.landurbplan.2011.12.024.

Albrecht, K. (2002), *Organizational Intelligence and Knowledge Management: Thinking outside the Silos*, Executive White Paper.

Barry, A., Born, G. and Weszkalnys, G. (2008), "Logics of interdisciplinarity", *Economy and Society*, Vol. 37 No. 1, pp. 20-49, doi: 10.1080/03085140701760841.

Bensaude-Vincent, B. and Stengers, I. (1996), *A History of Chemistry*, Harvard University Press, Cambridge, Mass.

Bento, F., Tagliabue, M. and Lorenzo, F. (2020), "Organizational silos: a scoping review informed by a behavioral perspective on systems and networks", *Societies*, Vol. 10 No. 3, p. 56, doi: 10.3390/soc10030056.

Defila, R. and Di Giulio, A. (2018), "Reallabore als quelle für die methodik transdisziplinären und transformativen forschens - eine einführung", in Defila, R. and Di Giulio, A. (Eds), *Transdisziplinär Und Transformativ Forschen: Eine Methodensammlung, Open*, Springer, Wiesbaden, pp. 9-35.

Diekmann, P. and Leppert, H. (1978), *Planspiel Und Planspiel-Simulation in Der Raumplanung*, Birkhäuser Basel, Basel.

Fazey, I., Fazey, J.A., Fischer, J., Sherren, K., Warren, J., Noss, R.F. and Dovers, S.R. (2007), "Adaptive capacity and learning to learn as leverage for social–ecological resilience", *Frontiers in Ecology and the Environment*, Vol. 5 No. 7, pp. 375-380, doi: 10.1890/1540-9295(2007)5[375:ACALTL]2.0.CO;2.

Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005), "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources*, Vol. 30 No. 1, pp. 441-473, doi: 10.1146/annurev.energy.30.050504.144511.

Fuchs, M., Schnittfinke, T., Ohlmeyer, K., Gruehn, D. and Greiving, S. (2020), "Ex-ante impact assessment of urban interventions: the sustainability check at the example of the city of bottrop, Germany", *Journal of Extreme Events*, Vol. 7 No. 3, p. 2150005, doi: 10.1142/S2345737621500056.

Galderisi, A. and Limongi, G. (2017), "Beyond a fragmented and sector-oriented knowledge for a sustainable and resilient urban development. The case of the Metropolitan City of Naples", in Deppisch, S. (Ed.), *Urban Regions Now and Tomorrow*, Springer Fachmedien Wiesbaden, Wiesbaden, pp. 41-71.

Galison, P. and Stump, D.J. (Eds) (1996), *The Disunity of Science: Boundaries, Contexts, and Power, Writing Science*, Stanford University Press, Stanford, Calif.

Holling, C.S. (Ed.) (1978), *Adaptive Environmental Assessment and Management*, Blackburn Press, Caldwell, NJ.

Huning, S., Räuchle, C. and Fuchs, M. (2021), "Designing real-world laboratories for sustainable urban transformation: addressing ambiguous roles and expectations in transdisciplinary teams", *Sustainability Science*, Vol. 16 No. 5, p. 143, doi: 10.1007/s11625-021-00985-0.

Intergovernmental Panel on Climate Change (IPCC) (2022a), *Climate Change 2022: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, New York, NY, Cambridge.

Intergovernmental Panel on Climate Change (IPCC) (2022b), *Climate Change 2022: Mitigation of Climate Change: Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, New York, NY, Cambridge.

Keen, M., Brown, V.A. and Dyball, R. (Eds) (2005), *Social Learning in Environmental Management: Towards a Sustainable Future*, Earthscan, London.

Kriz, W.C. and Hense, J.U. (2006), "Theory-oriented evaluation for the design of and research in gaming and simulation", *Simulation and Gaming*, Vol. 37 No. 2, pp. 268-283, doi: 10.1177/1046878106287950.

Laclau, E. and Mouffe, C. (2001), *Hegemony and Socialist Strategy: Towards a Radical Democratic Politics*, 2. ed. Verso, London.

Lawrence, R.J. and Després, C. (2004), "Futures of transdisciplinarity", *Futures*, Vol. 36 No. 4, pp. 397-405, doi: 10.1016/j.futures.2003.10.005.

McCrum, G., Blackstock, K., Matthews, K., Rivington, M., Miller, D. and Buchan, K. (2009), "Adapting to climate change in land management: the role of deliberative workshops in enhancing social learning", *Environmental Policy and Governance*, Vol. 19 No. 6, pp. 413-426, doi: 10.1002/eet.525.

Meier, R.L. and Duke, R.D. (1966), "Gaming simulation for urban planning", *Journal of the American Institute of Planners*, Vol. 32 No. 1, pp. 3-17.

Messerschmidt, R. and Zadow, A. V (2018), "Prozesse und beteiligung", in Bott, H., Grassl, G.C. and Anders, S. (Eds), *Nachhaltige Stadtplanung: Lebendige Quartiere – Smart cities – Resilienz, Edition DETAIL, 2. Ed., Edition DETAIL*, Munich, pp. 54-59, doi: 10.11129/9783955534318-011.

Meuleman, L. (2021), "Public administration and governance for the SDGs: navigating between change and stability", *Sustainability*, Vol. 13 No. 11, p. 5914, doi: 10.3390/su13115914.

Pahl-Weber, E. and Henckel, D. (Eds), (2008), *The Planning System and Planning Terms in Germany: A Glossary, Studies in Spatial Development*, Verlag der ARL, Hanover, Vol. 7.

Petts, J., Owens, S. and Bulkeley, H. (2008), "Crossing boundaries: interdisciplinarity in the context of urban environments", *Geoforum*, Vol. 39 No. 2, pp. 593-601, doi: 10.1016/j.geoforum.2006.02.008.

Räuchle, C. (2021), "Social encounter by experiment? Potentials and pitfalls of real-world labs for urban planning", *Urban Planning*, Vol. 6 No. 1, pp. 208-220, doi: 10.17645/up.v6i1.3475.

Reed, M.S., Evely, A.C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C. and Stringer, L.C. (2010), "What is social learning?", *Ecology and Society*, Vol. 15 No. 4.

Regional Association Ruhr (RVR) (2019), (Eds), "Klimaanalyse stadt bottrop", available at: www.bottrop.de/wohnen-umwelt-verkehr/umwelt/klimanalyse-stadt-bottrop-2019.php (accessed 4 October 2021).

Schusler, T.M., Decker, D.J. and Pfeffer, M.J. (2003), "Social learning for collaborative natural resource management", *Society and Natural Resources*, Vol. 16 No. 4, pp. 309-326, doi: 10.1080/08941920390178874.

Sieber, R., Faulenbach, L., Fuchs, M. and Gülleken, L. (2022), "The challenges of co-research in labs in real-world contexts: empirical findings from four labs in the context of urban climate-change research", *Town Planning Review*, Vol. 93 No. 2, pp. 139-163, doi: 10.3828/tpr.2021.24.

Walters, C.J. (1986), *Adaptive Management of Renewable Resources*, *Biological Resource Management*, Macmillan, New York, NY.

Walters, C.J. and Holling, C.S. (1990), "Large-scale management experiments and learning by doing", *Ecology*, Vol. 71 No. 6, pp. 2060-2068.

Weber, M. (1922), *Wirtschaft Und Gesellschaft: Grundriss Der Verstehenden Soziologie*, Tübingen.

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