Vol. 156, No. 4 · Short communication

DIE ERDE

Journal of the Geographical Society of Berlin

Knowledge Transfer for Climate Adaptation in Hessian Municipalities: Hurdles, Needs and Tailored Solutions

***Verena Rossow*[1*], *Thomas Friedrich*[2]**

[1] *Institute for Social-Ecological Research (ISOE), Hamburger Allee 45, 60486 Frankfurt/Main, Germany; verena.rossow@isoe.de; https://orcid.org/0000-0002-5064-2840*

[2] *Institute for Social-Ecological Research (ISOE), Hamburger Allee 45, 60486 Frankfurt/Main, Germany; Senckenberg Biodiversity and Climate Research Centre (SBiK-F), Georg-Voigt-Straße 14-16, 60325 Frankfurt/Main, Germany; thomas.friedrich@isoe.de; https://orcid.org/0009-0001-8218-5082*

[*] *corresponding author*

Manuscript submitted: 15 November 2024 / Accepted for publication: 3 February 2026 / Published online: 11 May 2026

Abstract

Local administrations are key to implementing climate adaptation but differ widely in readiness and expertise. Growing numbers of knowledge transfer programs aim to support and empower municipal stakeholders. To be most effective, these programs must be tailored to specific target groups. This study illustrates a research-based knowledge transfer process and its potential for municipal climate adaptation in Germany. Expert interviews and a survey of municipal employees in Hesse, Germany, identified knowledge gaps and barriers. We show how tailored knowledge transfer can be achieved and emphasize the need for targeted support and training, offering valuable insights for knowledge transfer practitioners.

Keywords climate adaptation, Germany, Hesse, knowledge transfer, municipal survey

1. Knowledge Transfer for Municipalities to Enable Climate Adaptation Measures

Municipal administrations are the smallest units of government in the Federal Republic of Germany and play a central role in climate adaptation. Under the German Climate Adaptation Act (*Klimaanpassungsgesetz*), federal states can oblige municipalities to implement local adaptation strategies (Fischer-Hotzel & Meyer, 2024). Yet, a recent nationwide survey reveals that municipalities vary considerably in their level of preparedness and progress (Friedrich et al., 2024). Their spatial and climatic conditions, and thus their needs, vary widely, affecting both scientific understanding of climate change and knowledge of adaptation options. Moreover, administrative structures and responsibility allocation influence how knowledge and data are shared and applied. To implement adaptation measures effectively, municipalities need not only financial and human resources but also diverse forms of knowledge (Friedrich et al., 2024; Friedrich & Rossow, 2023; Fünfgeld et al., 2023).

Rossow, V., & Friedrich, T. (2025). Knowledge transfer for climate adaptation in hessian municipalities: Hurdles, needs and tailored solutions. *DIE ERDE*, *156*(4), xx–xx.

CC BY SA

https://doi.org/10.12854/erde-2025-756

For administrative employees, climate adaptation is a cross-cutting task involving multiple municipal departments (e.g., Friedrich et al., 2024; Teebken & Schipperges, 2024; Otto et al., this issue). To prioritize suitable and feasible adaptation measures, extensive knowledge must be consolidated and made accessible in a tailored, comprehensible way. Knowledge is inherently linked to people, and translating it into action depends on individual skills, capacities, motivations, and resources. In municipal administrations, knowledge is organized, that is, stored, shared, and selectively accessed. Yet, its coordination and communication often form a bottleneck managed by few people with executive responsibility (see Erl et al., 2019). Therefore, a knowledge transfer approach should address both individual actors and the organizational processes of knowledge management, aligning with recipients' needs.

In this context, it is helpful to distinguish between three types of knowledge, common in transdisciplinary projects: *system knowledge* (understanding how the municipality functions and is affected by climate change), *target knowledge* (defining desirable climate-resilient futures), and *transformation knowledge* (knowing how to achieve them; see Pohl & Hirsch Hadorn, 2008). Higher-level government agencies, such as the state governments (*Bundesländer*) or the federal government, play a crucial role in supporting municipalities by contributing to these knowledge types in different ways, for example, by providing standardized data and regulatory frameworks (system knowledge), setting goals or mandates (target knowledge), or enabling capacity-building and funding instruments (transformation knowledge). Municipalities, in turn, must adapt this knowledge to their local context, often struggling to integrate it into administrative practice.

To foster knowledge transfer for climate adaptation, the Centre on Climate Change and Adaptation of the federal state of Hesse (*Fachzentrum Klimawandel und Anpassung*, FZK; part of the Hessian Agency for Nature Conservation, Environment and Geology [*Hessisches Landesamt für Naturschutz, Umwelt und Geologie,* HLNUG]) was one of the first specialized centers in Germany to support municipalities in an advisory capacity. Since 2008, it has provided local data, for example, on extreme weather events and their impacts, offered planning guidance, and organized webinars and events. The following section presents results from a research and transfer project in Hesse, commissioned by the FZK (Rossow et al., 2025). It aimed to assess the state of knowledge on climate adaptation in Hesse, identify municipal knowledge gaps, and address them through a customized, target group-specific transfer format. Based on this project, this article highlights the importance of knowledge transfer in the field of municipal climate adaptation.

2. Specifying Knowledge Requirements within Municipal Administrations

2.1 Methodological Approach of the Online Survey

The research project focused on municipal employees in Germany involved in climate adaptation. Initial, semi-structured interviews were conducted with five climate adaptation experts from federal and state advisory bodies to critically assess the literature-based diagnosis of municipal climate adaptation barriers (e.g., Fünfgeld et al., 2023). Based on these insights, we designed a comprehensive online survey to determine municipalities' actual knowledge requirements on climate adaptation as well as opportunities for enhancing institutional knowledge transfer. The survey was conducted in 2022 and sent to all 442 Hessian municipalities (421 towns and communities, in German: *Städte* and *Gemeinden*, and 21 counties, in German: Landkreise). Using general mayoral contact details or climate-related officials, 925 email addresses were identified and contacted.

In a cover letter, recipients were asked to forward the survey to those responsible for climate adaptation, noting that multiple responses per municipality were welcome to get as broad a picture as possible. As literature (Vetter et al., 2023) and expert interviews indicated that responsibilities were often unclear, particularly in small municipalities, the survey aimed to capture diverse individual assessments, perspectives, needs, challenges, and activities related to municipal climate adaptation in Hesse (Friedrich & Rossow, 2023; Rossow et al., 2025).

175 people participated in the survey, a number that does not represent all municipalities. However, the distribution of respondents by municipality size closely mirrored the actual size distribution in Hesse.

2.2 Climate Adaptation Management—a New Professional Field

Local climate adaptation management with dedicated employees has only recently begun to receive federal funding (Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz [BMUV], 2022), indicating a dynamic labor market in this area. This trend is also reflected in our data, as the increasing importance of climate adaptation is leading to a rise in job numbers and a corresponding need for knowledge and information.

The data from the online survey reveal significant differences in respondents' experience with municipal climate adaptation. For more than one quarter of respondents (26%), climate adaptation was not formally part of their job description. Of the remaining respondents, around a quarter (26%) have been working in this field for less than twelve months, while more than 40% already have up to three years of experience. Overall, 80% have less than five years of experience in the field (Table 1).

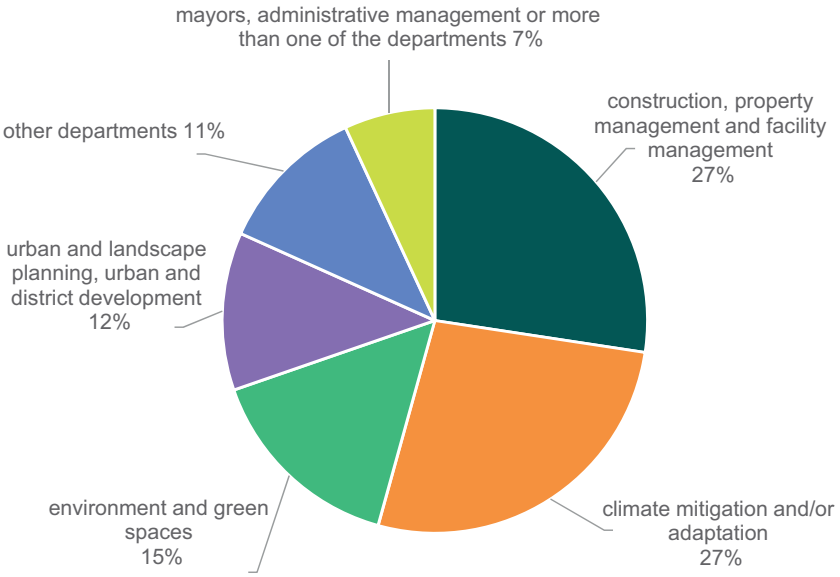
The relatively recent accumulation of experience in climate adaptation is mirrored by a heterogeneous integration of the topic across various municipal departments. As depicted in Figure 1, just over a quarter of respondents (27%) state that they work in a department explicitly dedicated to climate mitigation and/or climate adaptation, while a similar share stated that their work focuses on construction, property, or facility management. This distribution reflects growing thematic differentiation and specialization within larger municipalities and cities, which typically have more complex administrative structures and greater capacity for thematic specialization (e.g., Eckersley & Haupt, 2021; Göpfert et al., 2019; Otto et al., 2021). Especially larger cities are therefore more likely to be able to employ staff with a high level of expertise in specialized areas.

Table 1 Initial Network Establishment

"How long have you been dealing with the topic of climate adaptation in your work?"				
less than a year 26%	between 1 to 3 years 42%	between 3 to 5 years 12%	more than 5 years 20%	**total** **100%**

Note. Source: Own elaboration. n = 130; only respondents who stated that climate adaptation is part of their job responsibilities.

Figure 1 Areas of Specialization of the Respondents



Note. Question: "In which of the administrative areas do you mainly work?" (n = 175). Source: Own illustration, Institute for Social-Ecological Research (ISOE).

The group of actors most frequently mentioned in our survey as points of contact for climate adaptation in their municipalities reflects the diverse circumstances in terms of administrative capacities and responsibilities (see Figure 1). In some cases, specialized staff fill this role, while in others, especially smaller ones, mayors themselves responded due to limited resources. This highlights a characteristic challenge: Responsibilities are often informally assigned or cross-cutting rather than institutionally embedded. However, this does not indicate a lack of engagement but underscores the need for clearer formal roles and capacity building, as also noted in recent studies on municipal climate governance in Germany (see Fünfgeld et al., 2023).

From an administrative point of view, municipal climate adaptation is a classic cross-cutting issue, impacting various departments and sectors. It requires cooperation between different departments such as urban planning, environment, health, and infrastructure to develop effective, sustainable solutions. This need for integration often conflicts with existing organizational and governance structures, making it difficult for local governance processes to fully address climate change impacts (e.g., Ekstrom et al., 2011).

2.3 Different Types of Knowledge (Formats) Required

As the data above suggest, the qualifications of those working on climate adaptation are shaped by factors such as work experience, training, and specific work contexts. The relatively young labor market in this field indicates that professional structures, knowledge foundations, and routines are still developing. These individual and structural factors interact, influencing employees' knowledge, commitment, and professional growth.

To address knowledge gaps in administrative structures with appropriate transfer formats, it is clear that target groups differ in their levels of knowledge, which is crucial for understanding their needs and how to address them. Those responsible for climate adaptation are not only tasked with implementation but also with driving structural changes within administrations. As described by Battilana et al. (2009), climate action managers have an unconventional role as *change agents* in traditional public administration. This requires them to be able to navigate between formal expertise and informal organizational dynamics, drawing on both explicit and tacit knowledge (Bickel et al., 2020).

This distinction between different types of knowledge is particularly important when those responsible for climate adaptation at the local level seek support and cooperation within their municipalities. When it comes to knowledge building and awareness raising in particular, survey respondents indicate that the level of knowledge available within their departments varies greatly (see Figure 2).

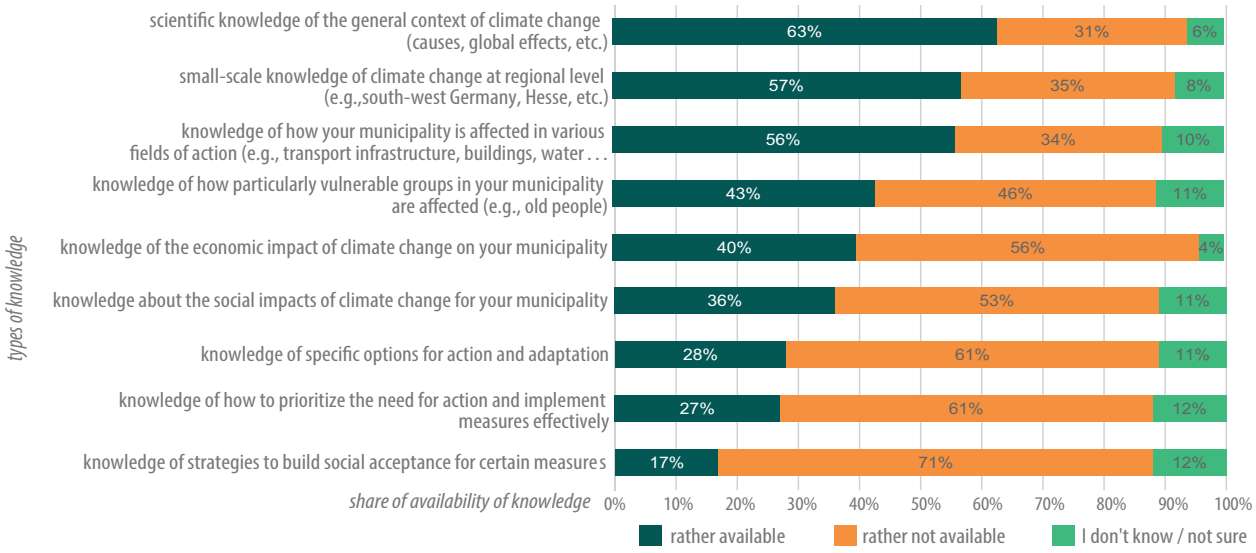
Respondents report that municipalities lacked not so much basic scientific knowledge about climate change in general or its regional and local impacts, but rather knowledge on the practical implementation of strategies and measures. Still, almost one third note a lack of basic scientific knowledge. Moreover, the more specific the questions about climate impacts, the more frequently respondents report knowledge gaps. This suggests likely obstacles in selecting, prioritizing, and implementing adaptation measures.

A closer look at the availability of "specific options for action and adaptation," differentiated by municipality size (see Figure 3), also shows uneven knowledge distribution. Only about a third of employees in very small municipalities state that such knowledge exists within their municipalities.

This highlights that smaller municipalities have different organizational conditions for knowledge processing than larger or medium-sized municipalities/cities and administrations in rural areas. For knowledge transfer purposes, this variation makes it essential to design tailored formats for different municipality sizes. Preferred methods of knowledge dissemination differ accordingly. Some target groups favor passive formats such as academic presentations and argumentation guides, while others prefer active formats like excursions (see Figure 4). In our case, these preferences strongly correlate with municipality size, reflecting differences in professional structures, organizations, and available resources.

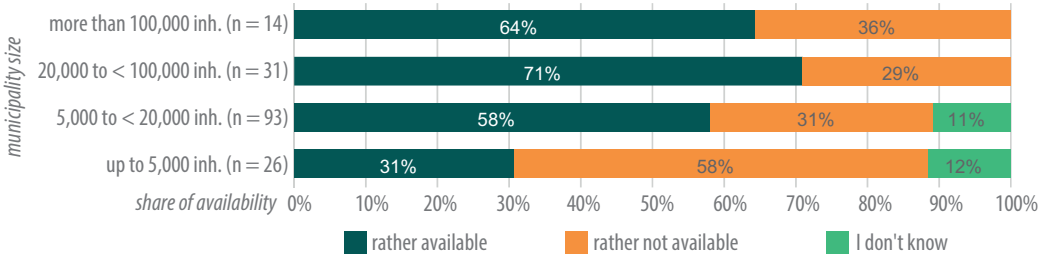
Overall, the survey indicates that municipal knowledge deficits relate less to the scientific basis of climate change and more to practical implementation, particularly creating social acceptance, prioritizing measures, and identifying concrete options for ac-

Figure 2 Types of Knowledge



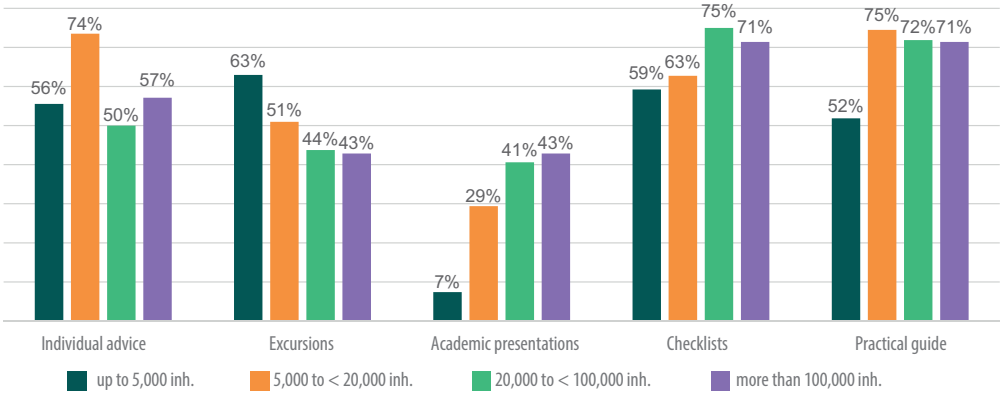
Note. Question: "In order to successfully implement climate adaptation measures, a large amount of data and information is needed. What relevant knowledge is or is not available in the administration of your municipality?" (n = 175, source: Rossow et al., 2025, p. 44, own translation).

Figure 3 Estimations of the Respondents on the Availability of "Knowledge About Specific Options for Action and Adaptation Within Their Municipality



Note. Sorted by municipality size (inhabitants; n = 164). Source: Own illustration, Institute for Social-Ecological Research (ISOE).

Figure 4 Discrepancies in Preferences for Transfer Formats, According to the Size of the Municipalities



Note. Question: "To obtain more information on the fields of climate adaptation action relevant to your municipality: Which of the following information and advice services would you make use of?"; a selection of answer options is shown (n = 175; source: Own illustration, Institute for Social-Ecological Research [ISOE], Rossow et al., 2025, p. 73).

tion. Preferences for transfer formats also varied markedly by municipality size. Smaller municipalities favor accessible and practice-oriented exchange formats, while larger cities and counties are more open to specialized, formal knowledge products. This underscores that effective knowledge transfer must address specific deficits while also aligning formats with the organizational capacities of differently sized municipalities.

3. Tailoring Research-Based Knowledge Transfer

Recent empirical research (see, for example, Friedrich et al., 2024) has confirmed knowledge gaps and implementation barriers in municipal climate adaptation, with varying starting conditions across municipalities. These differences highlight the need for tailored approaches to knowledge transfer, taking into account the distinct prerequisites and capacities of different actors. Knowledge transfer, particularly in the field of sustainability research, aims to promote the impact of research on society by using targeted methods and formats to address specific groups. This is intended to foster mutual learning between science and society (see Schuldt-Baumgart & Rossow, 2023). Given the diverse professional challenges in municipal climate adaptation, including varying job profiles and experience levels among staff (see above), carefully selected transfer formats need to be developed that can effectively address different knowledge gaps.

Interactive formats, such as workshops, link the learning process to social experience, fostering both knowledge gain and commitment to follow-up actions. These formats are often more effective for increasing acceptance than unidirectional information delivery. Interactive, inter-municipal exchange is particularly valuable for climate adaptation, as peer-to-peer transfer of knowledge about strategic approaches in complex administrative structures is highly beneficial (Kaiser et al., 2023; Schönefeld et al., 2023). Excursions further enhance this by providing practical examples of climate adaptation measures and facilitating thematic exchange along with social interaction.

Passive (or *silent*) formats such as checklists, on the other hand, require greater self-motivation and promote less social learning. They are useful when it comes to providing valuable guidance, structuring knowledge, or outlining administrative procedures. However, they are less useful for tasks such as prioritizing measures, especially when there is a lack of experience in planning or implementing such measures.

The findings of our study suggest that municipal climate adaptation may thrive when cooperation is strengthened, cross-departmental knowledge is shared, and networks beyond local administrative boundaries are established. However, the question of who should cooperate with whom, build networks, or create a common knowledge base, and so forth, is not an easy one to answer. It touches on different political responsibilities in Germany's federal multi-level system, but also on legal and scientific uncertainties. For knowledge transfer, it is therefore crucial to take into account the needs of both experienced staff and newcomers, and to integrate both explicit and tacit administrative knowledge through dialogue-oriented formats.

4. Conclusion & Outlook

In this short communication, we argue on the basis of the research project presented how important it is for knowledge transfer in the field of municipal climate adaptation to first capture diverse local perspectives of the relevant actors. Without this, knowledge needs such as how to create social acceptance for certain measures or how to prioritize adaptation options cannot be addressed in a targeted manner.

This research revealed significant disparities in the level of knowledge and practical experience among municipal employees, particularly in smaller municipalities, highlighting the need for tailored support and training. By addressing specific contexts, challenges, and knowledge gaps, we showed how differentiated knowledge transfer could empower local administrations' capacities for climate adaptation.

Ultimately, the effectiveness of knowledge transfer depends on administrative structures and their ability to handle cross-cutting issues like climate adaptation. Despite structural limits, targeted and customized transfer formats can enhance municipal capacity. Advancing climate adaptation in municipalities through targeted knowledge transfer thus requires:

1. Combining research and transfer development: A systematic overview of municipal climate adaptation efforts, identifying deficits, obstacles, and diverse target groups is essential. This enables a clearer understanding of heterogeneous conditions. Integrating research into the knowledge transfer process allows the development of highly context-specific and practical solutions.
2. Integrate the target group's perspective: Effective knowledge transfer must fit employees' working contexts and conditions. Transfer activities are most impactful when target groups can articulate and contribute their needs in advance.

This research also revealed remaining research gaps. Our methodology did not permit a fully representative picture of climate adaptation in Hessian municipalities. A broader study would help quantify knowledge deficits and action needs in Hesse. Given the urgency of climate adaptation, resources for knowledge transfer must be used efficiently and strategically to maximize impact. Integrating research and transfer, as demonstrated here, holds great potential, especially for systematically developing institutional knowledge transfer. Without scientific methodology, target groups would be hard to capture in their diversity. Ideally, practice partners from local authorities should be part of a project consortium to test and apply the developed transfer formats directly in their municipalities.

Acknowledgments

We would like to thank the Centre on Climate Change and Adaptation of the Federal State of Hesse (Fachzentrum Klimawandel und Anpassung [FZK]; part of the Hessian Agency for Nature Conservation, Environment and Geology [HLNUG]) for commissioning and supporting this research. We are grateful to all participants who took part in the survey and expert interviews for their valuable time and insights. Furthermore, we thank the two anonymous reviewers for their constructive comments and suggestions, which helped to improve the quality and clarity of this manuscript.

Both authors contributed to the conceptualization, writing of the original draft, review and editing of the manuscript. Generative AI tools were only used for brainstorming. DeepL Write was used for linguistic improvements.

References

Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: Towards a theory of institutional entrepreneurship. *The Academy of Management Annals, 3*(1), 65–107. https://doi.org/10.1080/19416520903053598

Bickel, M. W., Caniglia, G., Weiser, A., Lang, D. J., & Schomerus, T. (2020). Multilevel knowledge management for municipal climate action: Lessons from evaluating the operational situation of climate action managers in the German Federal State of Lower Saxony. *Journal of Cleaner Production, 277*, 123628. https://doi.org/10.1016/j.jclepro.2020.123628

Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz (BMUV). (2022, April 21). *Steffi Lemke überreicht erste Förderbescheide für lokale Klimaanpassungsmanager*innen* [Steffi Lemke presents first funding approvals for local climate adaptation managers] Pressemitteilung. https://www.bmuv.de/pressemitteilung/steffi-lemke-ueberreicht-erste-foerderbescheide-fuer-lokale-klimaanpassungsmanagerinnen

Eckersley, P., & Haupt, W. (2021). Klimapolitische Steuerung: (Nicht nur) auf die Bundesländer kommt es an [Climate policy governance: It's not just up to the federal states]. *IRS Aktuell, 97*, 12–17.

Ekstrom, J. A., Moser, S. C., & Torn, M. (2011). *Barriers to climate change adaptation: A diagnostic framework* (Publication No. CEC-500-2011-004). California Energy Commission.

Erl, T., Gonser, M., Eckart, J., Häußler, E., & Riel, J. (2019). Kommunale Akteure verstehen: Verteilte Wissensbestände in Kommunen beachten [Understanding municipal actors: Taking into account distributed knowledge bases in municipalities]. In R. Defila & A. Di Giulio (Eds.), *Transdisziplinär und transformativ forschen* (Vol. 2, pp. 139–145). Springer. https://doi.org/10.1007/978-3-658-27135-0_6

Fischer-Hotzel, A., & Meyer, N. (2024). *Point of view. Climate Adaptation Act – Everything can, little must.* Deutsches Institut für Urbanistik. https://difu.de/en/18640

Friedrich, T., & Rossow, V. (2023). Wissenstransfer für Klimaanpassung: Ergebnisse einer Kommunalbefragung in Hessen. [Knowledge transfer for climate adaptation: Results of a municipal survey in Hesse.] *Transforming Cities, 2*, 70–73.

Friedrich, T., Stieß, I., Sunderer, G., Böhmer, C., Murawski, W., Knirsch, F., Otto, A., & Thieken, A. (2024). *Kommunalbefragung Klimaanpassung 2023* [Municipal survey on climate adaptation 2023] (Climate Change). Umweltbundesamt. https://www.umweltbundesamt.de/system/files/medien/11850/publikationen/34_2024_cc_kommunalbefragung.pdf

Fünfgeld, H., Fila, D., & Dahlmann, H. (2023). Upscaling climate change adaptation in small- and medium-sized municipalities: Current barriers and future potentials. *Current Opinion in Environmental Sustainability, 61*, 101263. https://doi.org/10.1016/j.cosust.2023.101263

Göpfert, C., Wamsler, C., & Lang, W. (2019). Institutionalizing climate change mitigation and adaptation through city advisory committees: Lessons learned and policy futures. *City and Environment Interactions, 1*, Article 100004. https://doi.org/10.1016/j.cacint.2019.100004

Kaiser, T., Reichel, B., Kern, N., Weitz, L., Bojarra-Becker, E., Jolk, A.-K., Willen, L., Hohenwallner, D., & Kratzer, A. (2023). *Kommunen vernetzen: Peer-Learning zwischen Kommunen stärken und Anpassungskapazitäten erhöhen* [Connecting municipalities: Strengthening peer learning between municipalities and increasing adaptation capacities] (Climate Change 45). Umweltbundesamt.

Otto, A., Haupt, W., Eckersley, P., & Thieken, A. H. (2021). Ranking local climate policy: Assessing the mitigation and adaptation activities of 104 German cities. *Climatic Change, 167*, Article 9. https://doi.org/10.1007/s10584-021-03184-z

Otto, A., Friedrich, T., Back, Z., Schäfer, S., Schoenefeld, J., Schubert, A., Schulze, K., von Streit, A., Zorn, A. (2025). Using surveys to study local climate adaptation: Potential, challenges and recommendations from Germany. *DIE ERDE, 156*(4).

Pohl, C., & Hirsch Hadorn, G. (2008). Methodological challenges of transdisciplinary research. *Natures Sciences Sociétés, 16*, 111–121. https://doi.org/10.1051/nss:2008035

Rossow, V., Friedrich, T., Schuldt-Baumgart, N., Stieß, I., & Böhmer, C. (2025). *Wissenstransfer in Kommunen: Wissensbedarfe in der Klimaanpassung in Hessen*. [Knowledge transfer in municipalities: Knowledge requirements for climate adaptation in Hesse]. ISOE – Institut für sozial-ökologische Forschung. https://www.isoe.de/publikation/wissenstransfer-in-kommunen-wissensbedarfe-in-der-klimaanpassung-in-hessen

Schönefeld, J. J., Hildén, M., Schulze, K., & Sorvali, J. (2023). What motivates and hinders municipal adaptation policy? Exploring vertical and horizontal diffusion in Hessen and Finland. *Regional Environmental Change, 23*(53). https://doi.org/10.1007/s10113-023-02048-9

Schuldt-Baumgart, N., & Rossow, V. (2023). „Da machen wir eine schöne Broschüre draus!" Der Mehrwert von Wissenstransfer gegenüber Wissenschaftskommunikation und wie er sich erfolgreich gestalten lässt am Beispiel der Nachhaltigkeitsforschung. ["Let's turn it into a nice brochure!" The added value of knowledge transfer compared to science communication and how it can be successfully implemented, using sustainability research as an example.] *Transfer & Innovation, 4* (2023), 81–90.

Teebken, J., & Schipperges, M. (2024). *Soziale Frage Klimawandel: Klimaanpassung als sozialpolitische Gestaltungsaufgabe* [The social issue of climate change: climate adaptation as a socio-political task] (FES diskurs). Friedrich-Ebert-Stiftung. https://library.fes.de/pdf-files/a-p-b/21344-20240911.pdf

Vetter, A., Eisenack, K., Kind, C., Mahrenholz, P., Naumann, S., Pechan, A., & Willen, L. (2023). Anpassung an den Klimawandel als neues Politikfeld. [Adaptation to climate change as a new policy area]. In G. P. Brasseur, D. Jacob, & S. Schuck-Zöller (Eds.), *Klimawandel in Deutschland: Entwicklung, Folgen, Risiken und Perspektiven* (2nd ed., pp. 475–489). Springer. https://doi.org/10.1007/978-3-662-50397-3_32