

How Are Governance Capacities for Local Climate Action Formed? Applying the CAPS Framework to Heat and Drought Adaptation in Small and Medium-sized Municipalities in Austria

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Abstract

Small and medium-sized municipalities in Austria are increasingly affected by heat and drought. Still, empirical evidence for the formation of governance capacities for climate change adaptation and their translation into concrete action remains limited. This study applies the CAPacity building through Shared understanding (CAPS) framework conceptualizing local climate action as arising from social learning processes that link governance capacities and shared understanding of risk and coping appraisals. The study examines whether the CAPS elements can be distinguished empirically and whether they correspond to different levels of local climate action, comparing two frontrunner with four laggard municipalities in a heat-affected region in eastern Austria. A qualitative content analysis of 70 semi-structured interviews with local political leaders, administrative staff, and societal actors was performed. The results show that the risk appraisal of heat and drought is high and shaped by recent weather events. Municipalities with more diverse and active actors, better staff, financial, knowledge and communication resources, and sustained intermunicipal networks implement more systematic adaptation measures, whereas municipalities with weaker capacities rely on isolated responses. Frontrunner municipalities have higher response efficacy beliefs because they continuously roll out new and revise existing adaptation measures, while laggard municipalities tend to deny heat risks or attribute responsibility for climate action to external agents. The findings empirically confirm the elements posited by the CAPS framework; however, further studies are required to track social learning. Efforts to build local adaptive capacity should not only provide additional resources, but also provide more access to intermunicipal networks.

1 Introduction

Climate change adaptation has become an increasingly urgent topic not only in urban areas, but also in rural regions. Governments in rural regions, however, must also deal with the local impacts of other global crises and the day-to-day challenges in their local context (Haase et al. 2018). People implementing local climate action have to overcome substantial barriers, such as a competition for space and high investment costs, or balance the diverging values and interests of numerous stakeholders (Anguelovski and Carmen 2011). While many barriers to climate action governance and especially to climate change adaptation have already been identified and catalogued in the academic literature (Biesbroek et al. 2014), we still know little about how local governments overcome these barriers and develop local climate governance capacities. This is particularly true for small and medium-sized municipalities, which, on the one hand, often hesitate to engage in climate change adaptation initiatives (Buschmann et al. 2022; Fila et al. 2023) and, on the other hand, are notably underrepresented in academic research (Fünfgeld et al. 2023).

Many small and medium-sized municipalities need to adapt to increasing risks for heat and drought, as well as other climate-related hazards (Lehner et al., 2017). These have been observed in Central Europe and particularly in Austria, the area chosen for this study, which has experienced a marked increase in mean temperatures, drought frequency, and economic losses due to climate extremes in recent years

(Dasgupta et al., 2014; EEA, 2022; CCCA, 2023). In Austria—just as in other European regions—the sinking groundwater levels and increasingly restrictive water-use policies are affecting not only agriculture-based economies but also local livelihoods and ecosystems (Ellena et al., 2025; Rosegrant et al., 2009; Stupazzini, 2024). These environmental, social, and political challenges underscore the critical role played by robust and adaptive local governance (Bulkeley & Kern, 2006; Sajida, 2025).

This increase in climate risks raises the central questions addressed in this study: How do small and medium-sized municipalities deal with climate action challenges and barriers? How do they develop governance capacities that help them adapt to heat and drought? To shed light on these questions, the CAPS (CAPacity building through Shared understanding) framework developed by Radinger-Peer et al. (2025) is applied in this study to operationalize local climate action as the outcome of local governance capacities, supra-local governance arrangements, shared understanding and social learning. The CAPS framework elements are described in more detail in Section 2. This study applies the framework to empirically analyse the governance capacities of six heat-affected Austrian municipalities.

The level of climate action carried out in municipalities varies considerably (Clar & Steurer, 2014; Amundsen & Dannevig, 2021; Westskog et al., 2022). To examine this variability, the present study systematically contrasts frontrunner and laggard municipalities, which were classified according to the number and diversity of their adopted climate policy instruments. This contrastive case design allows an examination of the relationship between degrees of local climate action and CAPS framework elements. Contrastive case study sampling is well established in comparative politics research as a method for identifying underlying factors by comparing deliberately different outcomes (Seawright & Gerring, 2008). This method has been applied in climate governance research to systematically explore enabling and constraining conditions (Measham et al., 2011; Jordan et al. 2018).

The aim of the present paper is twofold: First, to illustrate how governance capacities for climate change adaptation are formed and put into practice in small and medium-sized municipalities at risk from heat and drought, and, second, to empirically confirm the CAPS elements as distinct factors connected by social learning processes. The study findings provide important information for practitioners and scholars seeking effective approaches that can be used to strengthen local adaptation governance.

2 Theoretical Background

The CAPS framework is a conceptual approach to analyze governance capacities for local climate action (Radinger-Peer et al., 2025). In the scope of this paper, ‘local’ refers to the lowest political-administrative level; in Austria, this is the municipal level (Schantl et al., 2021). While the importance of local governance capacities is firmly established (Hoppe et al., 2016; Wolfram et al., 2016), a notable research gap in understanding how such capacities can be built endogenously still exists. The CAPS framework posits that governance capacities emerge not only from formal structures and resources, but also through social learning. Social learning is an iterative process of reflecting on and exchanging information about perceptions of the problem, possible solutions, and experiences made when

implementing these solutions. In this feedback cycle, the local actors' appraisals are gradually harmonized to produce a shared understanding, and governance capacities are adjusted to meet local needs (Hölscher, 2020). This process eventually results in climate action that, if successful, spurs further improvements in shared understanding and governance capacities. Next, we present the definitions for the CAPS framework elements by quoting Radinger-Peer et al. (2025) and link them to empirical studies on local climate governance. Figure 1 illustrates how these elements interact.

Governance arrangements "at supra-local governance levels create the space for manoeuvre at the local level by setting agendas, assigning responsibilities to governance levels and institutions and passing/enforcing rules" (Radinger-Peer et al., 2025) but cannot be directly influenced by local actors (Villamayor-Tomas et al., 2019; Kronvall et al., 2023). Local governments rely heavily on support from and the regulations established by regional and state governments (Bulkeley, 2013; Hoppe et al., 2014): In countries with strong vertical policy coherence and shared responsibilities due to multilevel governance arrangements, local municipalities benefit from inter-governmental support systems (Bulkeley, 2013; Hoppe et al., 2014) such as funding programs and expertise (Nalau et al., 2015; Di Gregorio et al., 2019). A lack of vertical integration, and especially a lack of national guidance and regulation (Keskitalo et al., 2016) or vaguely defined responsibilities (Mees 2017), limit the uptake of local policy instruments (Buschmann et al., 2022).

Local climate actions are "planned and/or implemented activities by local actors that purposefully address climate change adaptation and mitigation in a local context" (Radinger-Peer et al., 2025). These actions range from information sharing and awareness raising to the enforcement of regulations and standards, financial incentives, and investments and even on to government operations, procurement, and organizational reforms (Capano and Howlett 2020).

"Local governance capacities comprise actors' capabilities and given conditions at the local governance level that increase or decrease the potential for local action" (Radinger-Peer et al., 2025). Governance capacities mirror the capitals approach, which uses natural, human, social, manufactured, financial, and cultural capital as indicators of adaptive capacities (Porritt 2007; Thaler & Seebauer, 2019; Williams et al., 2020). Robust and adaptive local governance is made possible when sufficient governance capacities (institutional, financial, administrative, participatory) are available, enabling municipalities to implement climate change adaptation (Mortreux & Barnett, 2017).

Radinger-Peer et al. (2025) also state, "Actors refer to the multitude of local representatives and key persons from policy, administration, businesses or civil society. Each actor has personal values and capabilities." Due to the plurality of political and private actors, accountability and mutual trust are crucial for effective and legitimate climate governance (Mees et al., 2018). Actors in local governance structures can adopt multiple roles that are shaped by formal mandates, informal social norms and power dynamics (Merton, 1957; further developed in governance research, e.g., Peters, 2018). Tosun and Schoenefeld (2017) emphasize the importance of local groups and initiatives that, embedded in multi-level networked governance structures, undertake organized and cooperative efforts to advance local

climate change adaptation. Similarly, local climate action in the United States relies on community engagement and the individual motivation “to do the right thing” (Salon et al. 2014). Participation in climate networks—both within and between institutions—significantly promotes actions in climate change adaptation (Aylett, 2015; Reckien et al., 2018).

Radinger-Peer et al. (2025) further point out, “Governance conditions comprise formal and informal institutions, organizational structures, availability of resources and legacies (e.g. budget, land use, settlement structures, influence)”. Institutional factors are key drivers of local climate action in European cities (Reckien et al., 2018), emphasizing that effective governance requires formal rules and sufficient resources (Ostrom, 2010). The concept of polycentric governance highlights the significance of multiple, overlapping institutional arrangements for strengthening local governance. In particular, resource availability is a central element of governance conditions (van Popering-Verkerk et al., 2022).

Radinger-Peer et al. (2025) also note that, “Shared understanding is the degree of (in-)congruence between actors regarding their respective threat appraisals (the cognitive and affective assessment of imminent climate risks), coping appraisals (the assessment of responses to reduce these risks regarding response efficacy, response costs and self-efficacy) and non-protective responses (the adoption of excuses and evasive arguments to downplay the risk, postpone actions or allocate responsibility/blame to others).” Strong empirical evidence indicates that shared understanding develops from experiencing climate extremes. Risk awareness, for example, increases after flood events (Keller et al., 2006; Ho, 2008; Bamberg et al., 2017). Direct experiences may undermine coping appraisal, if the affected actors realize they have only limited options in the face of an overwhelming hazard (Bubeck et al., 2018; Köhler & Han, 2024). Self-efficacy is a particularly critical determinant of high coping appraisal and adaptive responses (Seebauer & Babczyk, 2020). When individuals have a high risk appraisal but low coping appraisal, they tend to exhibit non-protective responses, such as denial, downplaying the gravity of the threat or distressing information, or externalizing responsibility to avoid personal accountability (Gifford, 2011; Whitmarsh, 2008; Babczyk & Seebauer, 2019).

“Social learning is a process of discourse among local actors that leads to a shared understanding and consequently joint practices and collective action” (Radinger-Peer et al., 2025). This process is widely recognized as essential for climate change adaptation, as it may result in convergent changes in perspectives and skills within social networks (Amorim-Maja & Olazabal 2025; Reed et al., 2009; Galan et al., 2023). Effective social learning processes rely on trust, balanced power relations, facilitation, and supportive institutions, all of which enable the iterative cycles of collaboration enhancing adaptive governance and local climate action (Keen et al., 2005; Collins & Ison, 2009; Pahl-Wostl et al., 2021).

3 Study area

In Austria’s federal state system, the Federal Ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management defines the overall strategy for climate change adaptation (BMLUK 2024) and helps municipalities implement adaptation measures, most

prominently through the Climate Change Adaptation Model Regions program (KLAR!) (Klimafonds 2025). Still, European, national, and provincial climate targets have not been broken down into binding statutory goals for the local governance level. Consequently, local adaptation efforts depend on self-interest, urgent problems, and available budgets rather than coordinated multi-level policies (Clar and Steurer 2019; Schindelegger et al. 2021; Winkler et al. 2026). Responsibilities for heat and drought management remain weakly institutionalized compared to flood protection (Seebauer et al. 2023). Most responsibilities fall to local governments because they control land-use planning and the implementation of building regulations (Adams et al., 2017). However, local governments often favor pragmatic planning decisions over strategic planning approaches (Forster et al, 2025), lack the ability to track the consequences of their decisions, and thus frequently overlook opportunities for climate change adaptation and mitigation (Raymond et al., 2017).

The study area is located in the Pannonian Basin in eastern Austria and comprises the six municipalities of Ebergassing, Lassee, Engelhartstetten, Gramatneusiedl, Obersiebenbrunn, and Moosbrunn. These municipalities range in size from 16 to 65 km² (except Gramatneusiedl with approx. 7 km²) and each have 1,800 to 4,400 inhabitants (see the Appendix, Table A.2, for details). None of these municipalities is currently part of a KLAR! region, which underlines their limited formal integration into Austria's structured climate change adaptation support programs. The area is characterized by intensive agriculture and its location as a suburb of Vienna; approximately 80% of the local workforce commutes to this nearby metropolitan region (Statistik Austria 2022).

These six municipalities face a broad range of climate-related challenges, but the adaptation challenges to heat and drought stand out. The region regularly experiences recurrent heat and drought events, and climate scenarios project that the frequency of these events is likely to increase in the next decades (Maraun and Roither 2023). Drought caused damage estimated at €130 million to agriculture in Austria in 2022 (Hagelversicherung 2022), and the year 2024 marked the hottest summer on record (Geosphere Austria 2024). Reduced winter snowfall and more erratic spring rainfall result in increasingly depleted groundwater sources before the growing season. (Formayer et al., 2025). Farmers have begun to adapt to these changes by increasing irrigation, changing soil management, and introducing heat-resistant crops (Kropf et al. 2025). In the nearby Seewinkel region, daytime irrigation bans in 2022–23 have been widely perceived as warning signs of the increasing water scarcity (Dreisiebner-Lanz et al. 2026; Winkler et al. 2026).

In order to allow a comparative analysis of the CAPS framework elements, the case study sampling method is applied to compare the two frontrunner municipalities Ebergassing and Lassee with the other four laggard municipalities. Frontrunner municipalities actively apply diverse adaptation instruments and participate in regional initiatives, while laggard municipalities rely on isolated *ad hoc* measures and limited cooperation (Radinger-Peer, 2025). This comparison allows the assessment of relationships between different levels of local governance capacities and the emergence of climate adaptation action.

4 Method

4.1 Data

Because most CAPS framework elements concern the inherently subjective perceptions of local governance actors, qualitative semi-structured interviews were conducted to record their perspectives, using an interview guideline that operationalized the framework elements (Flick, 2006). Factual information mentioned by interviewees, such as specific events or procedures, was verified by referring to policy documents and media reports.

From April to June 2023, the first round of 60 face-to-face interviews was conducted in the frontrunner municipalities Ebergassing (13 interviews) and Lassee (9), as well as in the laggard municipalities Engelhartstetten (10), Gramatneusiedl (9), Moosbrunn (9), and Obersiebenbrunn (10). Interviewees were purposefully selected based on their engagement with heat and drought issues and to ensure a broad representation of local actor groups, including mayors, municipal council members, public servants in municipal offices, farmers, fire brigade officers, representatives of local associations, and other civil society actors and residents (see the Appendix, Table A.1, for a list of interviewees). The interviews lasted 1 to 1.5 hours and were audio-recorded and transcribed for content analysis. One year later, from June to July 2024, a second round of interviews were conducted to assess how viewpoints and appraisals had changed and whether social learning had taken place. Due to the limited research resources, this second round of interviews was conducted with a selected group of key actors who could report on recent developments in the four laggard municipalities of Engelhartstetten (3 interviews), Gramatneusiedl (3), Moosbrunn (2), and Obersiebenbrunn (2).

4.2 Analytical approach

Interview transcripts were coded using the qualitative content analysis method (Mayring 2010) and MAXQDA software. Responses were first deductively coded by the elements of the CAPS framework, then the code system was refined and expanded inductively as additional aspects emerged during the analysis. The dependent variable in the analysis is local climate action, while the independent variables are the CAPS elements of actors, governance conditions, risk appraisal, coping appraisal, non-protective responses, and social learning in the six municipalities. Findings from the frontrunner municipalities are compared with those from the laggard municipalities and, where applicable, between different actor groups (e.g., farmers, residents). In this study, the term “municipality” refers to the smallest political and administrative unit within Austria’s political system. “Local authorities” comprise the mayor and civil servants who are responsible for executing policies in the municipal jurisdiction and are the residents’ direct political and administrative representatives.

5 Results

This section is structured according to the CAPS framework elements. Figure 1 summarizes the main findings for each element. Unless stated otherwise, all findings are based on the content analysis of the qualitative interviews. After describing the overarching governance arrangements faced by municipalities, the frontrunner and laggard municipalities are systematically compared regarding their

climate actions related to heat and drought, governance capacities, and shared understanding. The final subsection illustrates how diverse pathways to achieve local heat and drought adaptation emerge from the social learning dynamics between the CAPS elements.

5.1 Governance arrangements

National and provincial adaptation strategies define actions for local climate resilience that municipalities may adopt voluntarily (BMLUK 2024, Province of Lower Austria 2025). However, municipalities must comply with the *legal provisions* in spatial planning regulations that protect green spaces and with strict building codes that require energy efficiency in new construction (Province of Lower Austria 2026). However, as shown in Section 5.3.2 on resources, municipalities lack the staff and financial resources to fully meet these requirements, particularly when attempting integrated planning. They also lack a mechanism for conveying feedback to higher levels of governance, which would allow them to communicate local constraints and request prompt revisions in legal provisions.

New developments on greenfield sites continue although vacant buildings are available in village centers, contributing to soil sealing and suburban sprawl. These land use decisions are shaped by the economic interests of the municipality (e.g., higher tax revenues, more jobs), electoral considerations, and the existence of close personal ties between the authorities and real estate developers. Rapid *population growth* is increasing pressure on infrastructure and municipal budgets, as new residential areas, childcare facilities, and schools need to be developed. If resources are insufficient (e.g., due to declining tax revenues), authorities struggle to maintain and operate even the existing infrastructure. Under these conditions, adaptation to heat and drought tend to drop off the municipal agenda. Taken together, these arrangements may exacerbate each other and undermine local climate action efforts if they are not considered in local governance structures.

5.2 Local climate action

While many adaptation measures are available to the studied municipalities, they have implemented these measures to differing extents and showed different levels of willingness to adopt such approaches. This observation confirms that the contrastive case study sampling was successful, as frontrunner municipalities indeed show more climate actions than laggard municipalities.

Greening measures are recognized by most interviewees as an effective response to increasing heat, but the municipalities differ significantly in terms of how they (re)design their public spaces by planting trees, flowerbeds, or wildflower meadows. Frontrunner municipalities generally pursue more systematic and strategic approaches; for example, Lassee developed a management concept for roadside lawns and trains municipal gardeners accordingly. Since 2021, Ebergassing has planted one tree for each newborn child. The frontrunner municipalities experiment with measures that are still uncommon in rural areas, such as green roofs or resilient plant species. In contrast, laggard municipalities tend to rely on sporadic, *ad hoc* measures, such as planting a handful of trees along a new road or reducing the planned number of trees after resistance from nearby residents. Overall, their greening efforts focus on creating

additional green spaces rather than on safeguarding existing green structures. Presumably, this reflects the easy availability of land in rural areas compared to in urban environments, where public space is a rare and contested resource. Moreover, authorities do not have any legal basis for mandating the greening of existing buildings.

Adaptation activities in agriculture are implemented in both frontrunner and laggard municipalities. These measures are mostly driven by the funding conditions of the national scheme for the EU Common Agricultural Policy which subsidizes, for example, planting of cover crops to protect soils from erosion and drying or installing water-saving irrigation systems. However, some farmers act without funding incentives; for instance, one farmer from a laggard municipality successfully converted their farming practices to organic and mixed cropping in response to heat-related yield losses without applying for any agricultural subsidies.

Heat-adaptive everyday behaviors are promoted in all municipalities by means of awareness-raising and information campaigns. Frontrunner municipalities communicate heat-adaptive behaviors by running targeted educational programs, offering workshops, and sharing information via digital channels. These authorities cooperate with schools, associations, and local initiatives. Ebergassing distributes a monthly electronic newsletter to households with information on climate-related topics and trains municipal staff who have to deal with heat-related issues by inviting them to join webinars provided by the provincial environment agency. Laggard municipalities rely more heavily on traditional methods such as noticeboards and printed materials, which reach only a fraction of the residential population.

Small-scale building retrofits to improve indoor cooling are a topic in both frontrunner and laggard municipalities, and these are typically implemented reactively in response to heat stress. These retrofits include installing air-conditioning systems in the municipal council chamber and exterior sunshades in public and private buildings. Small-scale public installations such as drinking fountains, park benches, or canvas shading are not mentioned by the interviewees, possibly because they consider these measures to be negligible, unnecessary, or ineffective.

Maladaptive measures are short-term reactions that quickly remediate individual heat problems but have negative impacts on the entire municipality. Maladaptation appears in both frontrunner and laggard municipalities, such as the increasing installation of private swimming pools in response to increasing heat, which can negatively impact local water supplies in dry periods. Local authorities have begun coordinating or restricting pool filling to reduce peak demand and reserve the right to further restrict or even prohibit pool filling in times of water scarcity.

5.3 Local governance capacities

5.3.1 Actors

Key actors are essential to local climate action. Members of the municipal council and, most importantly, the mayor and the head of the municipal office are the crucial players for putting policies in place against

heat or drought. In frontrunner municipalities, the mayor and the head of office are seen as capable and influential individuals, and the municipal council has been dominated by one political party in the last election periods. These mayors enjoy a high level of trust, and their pro-environmental agenda is supported by the majority of the population and the municipal council. These mayors are described as open-minded when exchanging opinions with residents and as attentive to the municipality's long-term development. By contrast, decision-makers from laggard municipalities are consistently criticized for lacking the foresight to recognize future climate-related risks and for lacking the competencies needed to initiate adequate and timely action. Besides the municipal authorities, certain influential groups such as farmers are shaping public opinion and determining which issues appear on the local political agenda.

Interviewees identify two main types of actors as relevant for advancing local climate action: those who initiate new activities and those who ensure their continuation. The former are *role models* who, for instance, created the first green roof in their community, launched an initiative for planting more trees, or tried out new farming practices in crop rotation. The latter are characterized by their strong personal stamina and management skills, which allows them to act as *organizers* of events and association meetings. In frontrunner municipalities, both types are present and mutually reinforcing, which strengthens local governance capacities.

Networks appear as intramunicipal coalitions and intermunicipal cooperation. *Intramunicipal coalitions* between farmers exist in all municipalities and address water management, electrified irrigation, or shared machinery. In frontrunner municipalities, however, these coalitions involve not just farmers, but also other landowners who install buffer strips and plant hedgerows to mitigate soil erosion.

Participation in *intermunicipal cooperation* is clearly associated with the extent of local climate action. Participating local authorities profit from external expertise and strategic planning, in particular when larger-scale projects are planned and carried out, such the cycling routes and green corridors, that Lassee implemented together with its neighboring municipalities. Other examples of successful cooperation in frontrunner municipalities include the consolidation of dispersed agricultural plots and visits to best-practice examples in other municipalities. In laggard municipalities, intermunicipal cooperation only occurs occasionally and in uncoordinated ways, such as when municipalities lend each other mowing equipment for maintaining public green spaces. Interviewees from laggard municipalities point out the lack of resources and formal frameworks when asked why they do not engage in closer cooperation. Intermunicipal cooperation is often carried out under the umbrella of model region programs that are issued by provincial or national governments. Frontrunner municipalities are firmly established in these programs and value the ongoing communication, knowledge sharing, and access to expertise these offered. Beyond these programs, the interviews provided little evidence of systematic vertical cooperation between local authorities and higher governance levels in climate change adaptation.

5.3.2 Governance conditions

Governance conditions include the staff, financial, knowledge, and communication resources available to municipalities. These conditions are closely interlinked and mutually influence each other.

Local authorities face persistent *staff shortages* that affect their ability to plan and implement adaptation measures. Three main aspects contribute to these shortages. First, the head of the municipal office holds a pivotal position where most adaptation-related responsibilities converge. In a frontrunner municipality, a capable head of office enables cross-issue coordination and facilitates shared responsibilities, whereas laggard municipalities struggle to fill this position with a suitably skilled and respected candidate. Second, implementing adaptation measures requires specific professional skills, such as the ability to access, understand, and use regional climate data or to understand regulatory frameworks. Frontrunner municipalities provide respective training for their staff and seek cooperation with better-informed neighboring municipalities. Third, sufficient administrative capacity is needed to apply for external funding and manage funded projects. Because laggard municipalities lack staff with enough time and/or skills in these areas, they struggle to catch up with frontrunner municipalities.

Financial resources constrain all municipalities and force them to prioritize urgent needs, such as those to provide basic water and telecommunication infrastructures, schools, and care facilities, over adaptation measures. However, laggard municipalities have smaller disposable budgets in general, and their municipal councils tend to invest this budget in other purposes because they expect the future maintenance of adaptation measures would place an additional burden on their already strained personnel and financial situation. Frontrunner municipalities are significantly more active in acquiring external funding. They gain access to additional financial resources by means of intermunicipal cooperation, for instance, for planting climate-resilient trees, designating biodiversity zones, or signposting nature trails.

Frontrunner municipalities exhibit significantly better *knowledge resources* than laggard municipalities. They provide regular staff training in green space management, benefit from internal knowledge transfer, and maintain close exchange with intermunicipal and expert networks. Frequent cooperation with research institutions enhances their technical and system-level understanding of climate impacts and planning tools. Their longstanding experience in national and international projects promises to increase their chances of being involved in future projects. Frontrunner municipalities only do not outdo laggard municipalities in the area of agricultural adaptation; in all municipalities, farmers share their knowledge of plant selection and irrigation strategies. Frontrunner and laggard municipalities both refer to similar information sources regarding heat and drought. They also mostly rely on personal observations and conversations with other local actors and occasionally obtain professional advice from environmental and health agencies, energy providers, and regional initiatives. Communication between local and higher governance levels often are *ad hoc* and informal, depending on personal relationships.

Communication resources cited in frontrunner municipalities include regular informal communication channels for reaching residents, such as roundtables with the mayor or existing social meetings, where adaptation-related issues can be addressed. These formats provide low-threshold opportunities for

residents to voice their personal concerns and give the local authorities better insights into their needs. By contrast, in laggard municipalities climate change adaptation turns into a topic of everyday communication only during or after natural hazard events.

5.4 Shared understanding

5.4.1 Risk appraisal

Heat and drought are considered to be the most threatening climate change-related natural hazards in all analyzed municipalities. Risk appraisal is strongly influenced by *recent experiences*, particularly the dry and hot summers of 2021 and 2022, which had noticeable impacts such as crop losses and reductions in groundwater levels.

Awareness about heat impacts on agriculture and forestry is higher than about the health of private individuals. Farmers observe that consecutive extreme weather events occur more frequently. Especially hail and heavy rain following heat periods further increase the risk of crop failures. In some locations, drought combined with strong winds is recognized as an additional hazard that contributes to soil erosion and limits humus formation. Residents acknowledge an increase in the number of hot days, especially those who use groundwater wells located on their properties and had to extend their well shafts in the summer of 2022. However, despite their personal experiences, these residents rarely see heat risks as pressing enough to make major adaptations to their buildings, properties, or lifestyles. However, all interviewees agree that heat and dry periods will continue to increase in the *future*, eventually creating enough pressure to take action.

Interviewees present a mostly *cognitive* risk appraisal by rationally assessing recent events and personal observations. Both in frontrunner und laggard municipalities, some refer to *emotional* responses to heat and drought. Worries about the health implications of increasing heat are primarily expressed toward the wellbeing of future generations or the elderly. Farmers voice stronger affective responses, including feelings of frustration and powerlessness after weak harvests when they realized that their livelihood will be threatened if dry conditions persist.

5.4.2 Coping appraisal

While interviewees from frontrunner and laggard municipalities show similar perceptions of current and future heat and drought risks, interviewees frontrunner municipalities take much more positive views of their coping options.

In frontrunner municipalities, high risk appraisal coincides with strong coping capacities. The authorities in these municipalities enjoy high levels of trust and are described as long term-oriented and well-coordinated with local actors; these factors contribute to a high sense of *self-efficacy*. The frontrunner municipality of Lasse, for example, is a role model for residents and political actors from neighboring municipalities due to its best practices in creating green roofs or in its considerations of elderly people and children as vulnerable groups when making buildings more heat-resilient. Frontrunner municipalities

claim that their actions have clear, positive effects; that is, they attribute high *response efficacy* to their measures. Their combination of small, quickly visible successes and long-term strategies increases public acceptance of adaptation measures. While most interviewees view awareness campaigns for heat-adaptive everyday behaviors as effective, local authorities express frustration that some stubborn residents fundamentally oppose any measures. Furthermore, frontrunner authorities save resources and reduce overall *response costs* by jointly considering mitigation and adaptation measures during the planning phase for new residential developments or road renovations. While maintenance costs for green spaces pose challenges for frontrunner—as well as all other—municipalities, targeted plant selection, improved soil preparation, and better organization and training of municipal staff helps to keep maintenance costs down. Moreover, frontrunner authorities highlight the added value of creating more green spaces, such as the enhanced quality of public spaces, long-term savings in cooling energy, and lower heat-related morbidity.

Laggard municipalities, by contrast, express doubt whether local actions could truly achieve any meaningful impact. In addition to this low *response efficacy*, authorities in laggard municipalities are less trusted to be able to initiate appropriate measures and engage residents (low *self-efficacy*). Residents criticize that measures are implemented only sporadically and the lack of a comprehensive adaptation strategy. This is attributed to a lack of continuity among political decision-makers and their insufficient expertise. The *response costs* of greening measures are expected to outweigh the benefits, and costs are expected to increase in the future due to the additional workload for municipal gardeners.

However, in the areas of agriculture and forestry, the coping appraisals of frontrunner and laggard municipalities are mostly aligned. This can be attributed to the programs in the EU Common Agricultural Policy framework that apply across all municipalities and promote the use of drought-resistant crop varieties, set standards, offer subsidies, and provide advisory services. Moreover, the tangible experiences made in recent years illustrate the benefits of building climate resilience. Forest managers have become increasingly willing to introduce more resilient tree species, even though they are uncertain which adaptation measures will prove most effective and economically viable in an uncertain future climate.

5.4.3 Non-protective responses

The combination of high risk appraisal and low coping appraisal leads—especially in laggard municipalities—to non-protective responses that downplay the need to act or shift responsibilities onto others. *Denial* is reflected in statements that extreme weather has always existed or that adaptation is primarily an issue for urban areas, as well as in expressed views that the media exaggerate climate impacts. *Wishful thinking* is reflected in statements that cast doubt on the consequences of climate change, place hope in nature's ability to restore balance, or assume that negative consequences will not affect the interviewees personally.

Ambiguities regarding formal responsibilities further contribute to non-protective responses. Frontrunner as well as laggard municipalities clearly tend to *externally attribute the responsibility* for adaptation to

higher governance levels. While this blocks or delays climate action in laggard municipalities, since they wait for others to take the lead, frontrunner municipalities nevertheless move forward and use their local capacities as well as they can. The shifting of responsibility happens at multiple levels. At the global scale, major carbon emitters such as the USA and China are seen as responsible for taking action in climate protection, and many of those interviewed argue that Austria is too small to make a meaningful difference. At the Austrian scale, local authorities tend to assign responsibility for mandatory regulations, e.g. for improving energy efficiency in existing buildings or restricting water use, to the national or provincial level. Local policymakers even call for stricter requirements in these fields, but want these to be issued by higher governance levels so they could divert any blame or public backlash from their citizens. Residents, in turn, absolve themselves of personal responsibility and expect the local authorities to take action. For example, they call the fire brigade if their basements are flooded or trees are damaged and expect the authorities to initiate adaptation measures and perform ongoing maintenance.

5.5 Social learning

The CAPS framework posits that social learning takes place if local actors reflect on their different understandings of risks and coping options. The analysis of the interview contents indicates that social learning processes require several iterations. Virtuous or vicious cycles of social learning—resulting in an upward or downward spiral of local climate action—are only observed rarely in frontrunner and in laggard municipalities.

Frontrunner municipalities *learned from past experiences* and adapted their actions accordingly. For example, in Lasee, when tree roots damaged asphalt surfaces a few years after the trees were planted, the local authorities did not outright reject this adaptation measure. Instead, they sought external expertise, analyzed the plant species and their root space requirements, and provided targeted training for municipal staff, thus preventing similar problems in the future.

In contrast, laggard municipalities still experience considerable debate, and a shared understanding has not formed yet. Planting trees and expanding green spaces frequently encounters *hesitation or concerns* from residents due to uncertainty regarding the responsibilities for maintenance and costs. In reaction to resistance from residents, these municipal authorities tend to scale back the scope of greening measures. Furthermore, laggard authorities often hold single events, such as a workshop with external experts on making gardens climate-resilient, but do not organize follow-up activities, so that chances to build lasting knowledge resources are lost.

The second round of interviews in laggard municipalities reveals little evidence of social learning or notable changes in governance capacities. No new actors emerged in this period in the laggard municipalities. In Moosbrunn, for example, local authorities participated in a course on adaptation topics related to village center revitalization. They report sharing experiences and exploring potential future collaborations with other participants, but it remains unclear whether this exchange resulted in strengthened networks. Administrative and financial *resources show no evidence of increasing* or even

declined. For example, changes in funding procedures increased administrative workloads, placing further strain on municipal capacities. Social learning was further hindered by the significant impact on risk appraisal of extreme weather events that occurred shortly before the interviews. Heavy rainfall and flooding shifted the focus toward flood protection, overshadowing the previous year's concerns about heat and drought adaptation.

6 Discussion and conclusions

This study operationalizes the CAPS framework by Radinger-Peer et al. (2025) to analyze the formation of governance capacities for the adaptation to heat and drought in two frontrunner and four laggard municipalities in Austria. All municipalities are aware of the increasing heat and drought risk, but the actors and networks, resources, and the appraisals of response efficacy vary significantly between frontrunner and laggard municipalities. These variations result in substantial differences in these municipalities' governance capacities for turning risk awareness into concrete adaptation measures.

Frontrunner municipalities feature a more diverse and active set of local actors than the laggard municipalities. Mayors stand out as key actors, which reflects the broad-ranging competencies they possess in Austria: Mayors chair the municipal council and the municipal executive board, lead the municipal office, are the primary authority on building regulations and natural hazard management, oversee the execution of the municipal budget, and represent the municipality externally. This broad portfolio grants them significantly greater authority compared to mayors in other European countries (Österreichischer Gemeindebund 2022). The analysis of how local actors could advance climate action reveals two important roles, namely 'pioneers' and 'caretakers': Pioneers set the first impulse for local climate action by acting on their own initiative and inspiring others through their example, while caretakers step in after the pioneers have set the stage. The latter maintain and expand established contacts and networks and keep climate-relevant topics visible in their community. In frontrunner municipalities, local governance capacities are significantly enhanced because people are present who take up both roles. The success of local climate action often depends on a well-coordinated handover from the pioneers to the caretakers.

Frontrunner municipalities are deeply embedded in intermunicipal networks for knowledge sharing and external expertise. These networks provide them with a clear advantage in terms of carrying out adaptation activities. This finding is similar to that of De Gregorio Hurtado et al. (2015), who also find that national and international climate city networks support local policy activities.

Frontrunner municipalities command significantly better staff, financial, knowledge, and communication resources than laggard municipalities. These resources intersect; for instance, qualified staff are able to access external funding and have technical knowledge about adaptation measures. The institutional structures of frontrunner municipalities are more robust and generally involve formal (i.e. clear responsibilities, established routines) as well as informal relations (i.e., frequent exchange among actors, open communication with residents). This finding corresponds to the mutual reinforcement of

authority and capacity described by Rogers et al. (2024), where effective leadership requires the availability of adequate resources, and resource mobilization, in turn, strengthens local authority to act.

Finally, frontrunner and laggard municipalities differ in their response efficacy, that is, the perceived effectiveness of local adaptation measures. Frontrunner municipalities repeatedly refer to the observable positive outcomes of greening measures or revised planning routines, which strengthen their belief that local action can mitigate heat impacts and feed into social learning processes. Laggard municipalities, by contrast, often doubt whether local measures would make any difference. Their lack of response efficacy leads to non-protective responses such as denial, downplaying of risks, or shifting responsibility to higher levels of governance. Birchall and Kehler (2023) discuss such patterns of inaction as governance processes driven by denial and discretion. They note that denial manifests when actors reinterpret or disregard climate risks, or acknowledge risks without taking corresponding action. Discretion allows political and administrative actors to delay or delegate adaptation responsibilities to others. By adopting such non-protective responses, the local authorities in laggard municipalities maintain institutional stability and circumvent uncomfortable political or ideological conflicts.

Frontrunner municipalities not only have better governance capacities, but also engage in deeper social learning processes. These municipalities build efficacy beliefs and experiential knowledge by consistently rolling out and revising measures. They conduct regular reflection, open dialogue, and establish networks that enable them to learn from past experiences. Laggard municipalities, by contrast, take only tentative steps towards local climate action, which keeps them from entering social learning processes that would eventually improve their governance capacities. These municipalities seem stuck in a hesitant, short-term planning mode (Forster et al. 2025), where disagreements between local actors often result in symbolic gestures instead of effective action. Amorim-Maia and Olazabal (2025) confirm that successful climate adaptation is shaped by processes of social learning, which occurs through knowledge networks, transdisciplinary exchange, and community discourses and engagement.

6.1 Implications for research

Overall, support for the theorized structure of the CAPS framework is provided, since all elements of the framework appear in the empirical interview data. Frontrunner municipalities perform better with respect to all CAPS elements than laggard municipalities, underscoring the framework's assumed link between governance capacities, shared understanding, and local climate action.

The CAPS framework posits that social learning takes place if local actors reflect on their different understandings of risks and coping options. However, as shown in section 5.5, the interviews provide only limited evidence of actual social learning processes. Identifying and tracing the dynamic process of social learning posed a significant research challenge in this study. While changes in actor constellations and staff and financial resources can be mapped fairly easily with stakeholder lists and economic analyses, tracking the iterative development of knowledge and communication resources as well as risk

and coping appraisals remains a complex task that needs to consider sampling, longitudinal data and the starting point of social learning processes.

First, interviewee sampling should represent all local actor groups. The sample in the present study predominantly includes municipal authorities and other actors involved in administrative processes; this selection bias may color the results, representing local adaptation policy more strongly than everyday community practices.

Second, longitudinal data is necessary for tracking social learning over an adequate observation period. Our study was limited to a second round of interviews with a reduced sample after one year; this may have been insufficient for identifying gradual and implicit developments and may explain the small scope of observed social learning processes. Future research should therefore include longer observation periods, ideally over several legislative terms or throughout the planning, implementation, and maintenance phases of adaptation measures. Additional interview rounds could enable the identification of feedback loops; for instance, measuring shared understanding, climate action, and governance capacities in three interview rounds could show sequential impacts of these three elements.

Third, case study research like that conducted in the present study typically takes a snapshot of social learning processes that have been ongoing long before the research started. Our results underscore that frontrunner municipalities have reached their current high level of climate action as a result of a longer period of effort, since they built networks and resources over years and actively sought a shared understanding. Thus, we recommend setting a clear starting point for the observation of social learning processes, so that learning outcomes that result from developments before this point are not misattributed.

Finally, our study places an exclusive focus on heat and drought as climate risks. Future research could replicate the CAPS framework for examining local action in response to other climate-related hazards such as floods or hurricanes or in non-climate contexts such as blackout preparedness or earthquakes.

6.2 Implications for policy and practice

Our findings support the argument that building local adaptation capacity is not solely a matter of accumulating financial resources, for instance, by accessing national funding. The frontrunner municipalities demonstrate that it pays off to strategically build staff, knowledge, and communication resources. Increasing local adaptation capacity also requires fostering networks in which local actors learn and act together. These local networks can strengthen the authority of municipal leaders and motivate them to place adaptation on the policy agenda. Intermunicipal networks, meanwhile, enhance expertise, facilitate access to resources, and enable mutual support and solution sharing between neighboring municipalities. Climate action in small and medium-sized municipalities, however, needs clear arrangements with higher governance levels. The unclear assignment of responsibilities between governance levels leads to misaligned policy, since the municipalities do not deploy their power as, e.g., spatial planning authorities (Mees, 2017; Forster et al., 2025).

Our findings show that municipalities should encourage discussions on local climate action to improve shared understanding among all local key actors, as this is essential for entering and maintaining social learning processes. This discussion should focus on improving coping options, because these help to translate risk appraisal into action and counteract non-protective responses such as external attribution of responsibility.

Our results also emphasize that local authorities could profit from assigning pioneer and caretaker roles within their municipality. Both roles seem necessary for initiating and maintaining adaptation activities; assigning these roles also distributes the implementation burden and acts as a safeguard if a central actor drops out. In Lasee, for instance, the mayor, who had been an adaptation pioneer in his municipality, had to step down after the 2025 municipal elections, but the council member for environmental issues stayed in office and continued his agenda as a caretaker. This example underscores that adaptation governance depends on the institutionalization of roles, allowing momentum to be maintained even amid political or administrative change. Surprisingly, apart from the slow increase in climate risk awareness observed among farmers and foresters (which was most likely related to their livelihoods and close relationship with nature), we did not observe significant differences in the risk and coping perceptions among various actor groups. Thus, future efforts to align actor-specific viewpoints and achieve a shared understanding might need to include more detailed actor characteristics than just their occupational background.

Declarations

Author Contribution

H.P.E. Writing – original draft, formal analysis, visualization, conceptualization S.S. Writing – review & editing, methodology, conceptualization, validation V.R.-P. Writing – review & editing B.U. Writing – review & editing, data curation

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Data Availability

The qualitative interview data generated and analyzed during this study are not publicly available due to confidentiality obligations towards participants, but are available from the corresponding author on reasonable request and subject to data protection requirements.

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Figures

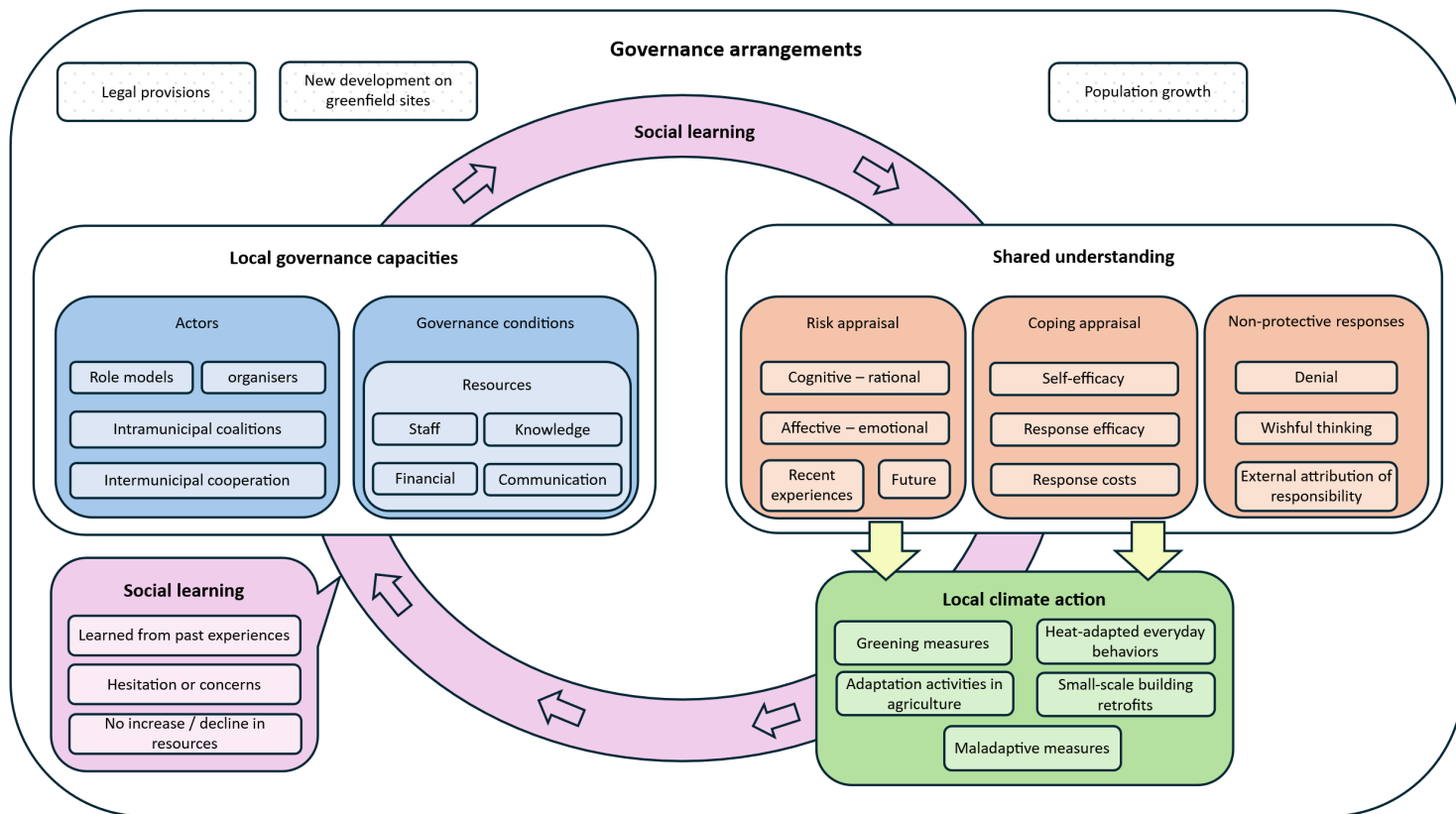


Figure 1

Key results assigned to the CAPS framework elements (based on Radinger-Peer et al., 2025)

Supplementary Files

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