

Article

New Policy Approaches for Increasing Response to Climate Change in Small Rural Municipalities

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Abstract: Although nearly half of the world population lives in rural small municipalities, research on climate change policy at this level is widely neglected. Frequently climate change adaptation is not a policy field in these small municipalities, which is both a problem and a risk. This paper aims at analyzing the climate policy of small and medium-sized local authorities with specific focus on adaptation. It presents results from a comprehensive survey among approximately 400 small municipalities in Bavaria, Germany. The study analyzes the perception of climate change risks and the perceived need for response, the fields of action, the triggering and influencing factors in the political process, and the people and bodies involved. Our findings reveal that in most cases small municipalities do not follow a strategic and holistic approach for climate change adaptation. Especially among small and very small municipalities, the study shows a gap between discussing climate change and setting up mitigation or adaptation measures. In conclusion, we present three policy implications for increasing the adaptive capacity of small municipalities. These address the increase of awareness of adaptation needs, effective management structures and the mandatory integration of a climate strategy into the long-term local political agenda.

Keywords: climate change; climate adaptation; small municipalities; adaptive capacity; climate policy; local communities

1. Introduction

Climate change has a twofold link to the municipality level. First, the largest share of greenhouse gas emissions is caused by human activity at a local level. Second, the impacts of climate change become concrete by events causing damage to the population in its settlement area: flooding, droughts, rock falls and heatwaves are only a few of the major types of catastrophes induced by climate change. It is therefore evident that an effective and cross-sectoral climate policy addressing mitigation and adaptation must be implemented not only at global and national but also at the local level. Such local climate policies must be tailored to specific local conditions and their related vulnerability and resilience of each municipality [1]. By concrete measures implemented on their territory, municipality governments can contribute significantly to better climate protection or shelter the local population from severe damage from natural disasters induced by climate change. Even in case of unavoidable disasters, the capacity to cope with the damages and other impacts is a concern, mainly at local level. By the constitutions of most nations, the municipalities are responsible for planning and implementation in many fields relevant to climate change, such as transport, settlement planning and housing or public services and supply [2]. Over decades, decisions taken in these fields determine the climate footprint, the vulnerability and the resilience of municipalities of all sizes.

Since 2005, more than half of the world population has been living in urban areas, and this proportion is still continuously increasing [3]. The United Nations expect a share of two-thirds, which is mainly caused by the dynamic population growth in the cities [4]. Therefore, large cities, especially the megacities with over 10 million inhabitants, play a central role in climate policy. Already today the share of carbon emissions of the 30 largest cities is about 12% of the total global emissions [5]. Because of their economic power and therefore high energy consumption, the contributions of cities are always higher than those of rural areas with the same area. However, the picture changes when looking at the emissions per capita. As cities can be organized more efficiently, the per capita emissions are usually significantly lower than in rural areas [6]. Considering the fact that nevertheless the absolute number of people living in rural areas will remain at nearly the same level of about 3 billion people, it is clear that climate policy in rural areas cannot be neglected.

Global, continental or national agreements or legislation always set the framework for implementation at all levels. Examples include the Paris COP21 agreement [7] at the global level, the EU 2030 climate and energy policy framework [8] at the continental level and the German climate protection plan 2050 [9] and China's national climate change program [10]. Looking at the 2030 framework document in Europe, it is clear that the role of the municipality level is central for its implementation. The European Council emphasizes that the framework respects the principle of subsidiarity [11]. Finally, in Europe this transfers the need for fixing and implementing a climate policy back to the municipality level for all fields of action which are within the responsibility of the local authorities. The German constitution (Grundgesetz, article 28, section 2) gives the local community responsibility for implementing all local community matters in accordance with the overall legal framework. If a municipality identifies a climate change induced vulnerability on its territory, this is a matter for the local community within the political multilevel system and obliges the local government to take care of it.

Successful climate change mitigation and adaptation at the local level requires three preliminary prerequisites to be fulfilled [12]: resources and capacities, knowledge and information, and institutions and governance. This leads to the question of the adaptive capacity [13] of the municipalities. Ryan [14] points out that a further important part of the climate governance process is that: "the extent to which a municipal climate policy is linked to local concerns greatly affects how local actors perceive the costs and benefits of a climate policy measure". In larger cities (20,000 inhabitants and above), all three key elements are usually manageable, at least at a minimum level. Smaller municipalities mainly located in rural areas suffer from very limited resources. In Europe, the financial crisis and the European stability pact have led to a significant reduction of the financial basis on the municipality level within the last two decades. In countries from other continents with lower GDP per capita than in Europe, the resources of rural municipalities are even more limited. Therefore, because of the obvious constraints of small local authorities, the question arises as to in what cases and to what extent are they able to define a climate policy and to implement related measures. According to this question, this article intends to investigate the role of climate policy at the municipality level, especially in rural small and medium sized local authorities. The recent literature revealed the significant need for research in this field. In particular, we argue for the importance of strengthening the responsibility on a local level and fixing the legal framework for the implementation of long-term strategies.

At first, a literature review shows the current status of research in the field of climate policy at the municipality level, and—more specifically—the climate policy of small rural municipalities. Secondly, a representative survey conducted among small municipalities in Bavaria provides an overview of the importance of climate policy as part of the political agenda. Based on the survey results, we discuss the key factors and responsibilities for starting and implementing a climate policy process. By conducting a cluster analysis, a typology with five governance types could be identified, which allows to determine critical aspects in current processual approaches. Finally, we conclude with three concrete policy implications how to overcome the deficits in municipality climate adaptation.

2. Literature Review

Early research on climate policies of cities and urban areas has its thematic focus on mitigation. One reason was a political aversion to the discussion of adaptation, as this was seen as capitulation in the fight against climate change [15]. Because of the dynamic growth of urban areas, their share of the total greenhouse gas emissions is constantly increasing. This explains why most of the publications discuss policy options for large cities or megacities [16] with special concern for their potential to reduce carbon emissions in the fields of energy production and supply [17] and the urban transport systems [18]. The Urban Climate Change Research Network (UCCRN) [19] and its scientists provide a large number of publications from this field as important contributions to the IPCC assessment reports. A further field of climate policy research is city networks [20], such as ICLEI (Local Governments for Sustainability) [21], Cities for Climate Protection or the C40 Cities Climate Leadership Group [22], comparing different mitigation policies and governance approaches [23]. A further concern of research is case studies about mitigation policy approaches of cities in emerging countries [24], e.g., in South Africa [25], India [26,27] or Mexico [28].

Forced by the work on the fourth IPCC assessment report after 2000, the academic literature on adaptation expanded rapidly [29]. Current and projected impacts of climate change were no longer only a hypothetical threat but became much more tangible through a continuously growing level of vulnerability [19,30] and observed extreme events. Therefore, the research in the field of risk analysis for cities with high vulnerability was especially intensified [31], e.g., in the fields of flooding [32,33], heat [34,35] or water supply [36,37]. Research on risks and their prevention for coastal areas is still one of the most intensively discussed areas [31,38–40]. Furthermore, adaptation as well as the aspect of resilience [41–43] of cities became part of the climate change research agenda.

As mitigation and adaptation were increasingly seen as two sides of one coin, research into integrated policy approaches, governance, and related instruments for cities can be found in recent literature. Concerning the structure and benefit of multilevel governance, Bulkeley and Betsill compare their 2005 study [44] with their 2012 findings on urban climate policy and state: “Climate change, it seems, is now firmly regarded as an issue with which cities can legitimately be concerned, albeit that the levels of engagement and interest in this agenda vary significantly. . . . It seems clear to us that any understanding of the multilevel governance must . . . consider the processes through which the political spaces of urban climate politics come to be configured and contested.” As the governance processes depend on the specific local situation and the regional and national framework conditions, it is obvious that there is no single best governance approach for all. Therefore a broad set of case studies dealing with climate change policy and governance can be found for cities and metropolitan areas. The comparative analysis of 100 cities by Castán Broto and Bulkeley [22] or the study of Araos et al. [45] comparing 401 cities worldwide can be cited as examples. Of particular interest were studies discussing the role of participatory approaches in the governance system [46,47].

There is very little literature about climate change policy at the municipality level in rural areas. Most publications discussing climate change in rural areas have a regional focus on specific risks for the local population caused by extreme events and permanent change of the climate conditions and also by the change of the production conditions of farming, forestry, fishing and tourism (e.g., Berghammer and Schmude [48], Trawöger [49]). Climate change policy approaches, more specifically governance approaches in small municipalities, are only found in some of the studies from European countries. Granberg and Elander’s [50] study from Sweden analyzes the central/local relations in climate policy on the basis of secondary sources, in order to evaluate the share of municipalities which adopted the climate mitigation goals from the national level. Reflecting future research, they conclude to “raise a more general question concerning the role of municipalities in governance”, but do not discuss the concrete role and responsibility within the multilevel-governance system. Three studies from Norway discuss the roles of the local or municipal (Aall et al. [51], Dannevig et al. [52]) and regional (county) levels [53] in climate change adaptation. All these studies underline the importance for policy

implementation, but they neither focus on small municipalities nor discuss specifically the governance approaches of the lower administrative levels.

Measham et al. [54] discuss the barriers and challenges of climate change adaptation at the municipality level in a case from the Sydney metropolitan area. This study does not include climate mitigation. The three municipalities which were selected for a qualitative study have populations ranging from 27,737 to 212,531. Compared with small municipalities in Europe these would be considered cities rather than small villages, and therefore a 1:1 transfer is questionable. However, at the level of small cities, the studied municipalities confirm three major constraints: a lack of information, institutional deficits and a lack of resources. The authors conclude that “it has taken local government a long time to embed climate mitigation into policy and practice, so it is not surprising that movement towards climate adaptation has been slow”. Furthermore, they underline the need for leadership to develop coordinated approaches. A survey conducted in the Portuguese territory by Campos et al. [55] analyzes the role of climate change in the municipal planning agenda, climate policy and actions as well as implemented measures. The sample covers all sizes of municipalities from small (22% below 7500 inhabitants, 23% from 7500 to 20,000) to large (29% up to 50,000, 15% between 50,000 and 100,000 and 11% 100,000 and above). The study does not explicitly analyze small municipalities, nor does it go into depth concerning the motivation or the local governance approach. More as a hypothesis than as a hard result, the authors conclude that in the Portuguese case that “the material, technocratic dimensions of responding to climate change are conceptualized under the scope of immaterial perceptions and values, which influence local interests and the decisions to act”.

Starting from 2004, more and more publications have discussed climate change adaptation in the context of social communities and their adaptive capacity. First, the focus was on decreasing vulnerability by increasing the adaptive capacity of local communities and related governance systems [56–58]. At the level of small municipalities and local communities, especially case-study-based research was done in Scandinavia [59,60]. The results of the cases reveal that a lack of co-operation as well as knowledge at the local level might be a general problem at the municipality level. Several authors later connected the research on adaptive capacity with the science area of social learning. Discussing a flood risk case of a Swedish municipality, Johannessen and Hahn [61] point out the need for multilevel learning approaches to increase local adaptive capacity by the use of knowledge available at higher levels and knowledge communities. Thi Hong Phuong et al. [62] show in a systematic literature review the interrelations of adaptive capacity (AC), social learning (SL) and climate change (CC) vulnerability or adaptation. They underline the existence of an interrelation among AC and SL, but at the same time they show that the type of interrelation and the weight of AC and SL depend on the type of CC-caused vulnerability. Although the review is not discussing explicitly AC and SL at the municipality level it shows the role of communities in SL as an instrument for capacity building.

The outcome of our literature review is that there is a lack of research in the field of climate change governance as well as adaptive capacity at the municipality level in rural areas and for small local authorities. Above all, no research results were found dealing with the motivation for starting a discussion of climate change or presenting research into local governance approaches.

3. Research Objectives and Methodology

Successful governance of climate change adaptation processes at the municipality level, not only in cities but also in small rural villages, is a key issue of the environmental and climate policy in Bavaria, Germany [63]. An instrument called “climate check” was developed within the Alpine Space Project “C3-Alps” (2012–2014) [64] to support adaptation processes at the municipality level. This tool aims at the systematic identification of relevant fields of intervention regarding climate-change-induced impacts [65]. It closes knowledge gaps and supports the small local authorities in their identification of the most relevant fields for adaptation. Finally, it gives an overview of appropriate adaptation measures and supports the local policy makers and administration in the design of tailored adaptation programs.

The feedback from the municipalities on the tool was very positive. Nevertheless, a few critical comments were also voiced, mainly with the same issue: the tool left the question open as to how to motivate the local stakeholders to put climate change on the political agenda and how to design the process leading to a climate change strategy at the municipality level. Therefore, in a second step, policy recommendations need to be developed concerning the design of climate change adaptation related local governance processes, especially for small and medium-sized local authorities (SMLA) with less than 20,000 inhabitants.

The main goal of this study was to examine what governance framework conditions and what governance process structures for SMLAs are required to install an effective and comprehensive climate policy on a municipal level. Our literature review of climate policy at the municipality level revealed research gaps in the question of integrated approaches (both mitigation and adaptation) and research into SMLA governance systems. In particular, the question of how a governance system should be designed to systematically steer an integrated process of mitigation and adaptation in smaller municipalities (e.g., Knieling and Leal [66]) has not been answered to date. The identification of these research gaps led to two central research questions for this study:

1. How to ensure the consideration of climate change in long-term SMLA policy-making processes.
2. How to steer the local policy-making process so that a broad acceptance can be achieved among all stakeholder groups of a SMLA.

Based on the results of the “C3-Alps” project, which worked with qualitative methods applied in two pilot sites, the new study was designed as a survey among small municipalities, and a quantitative approach was chosen to answer these two research questions. Furthermore, an additional focus was laid on climate change adaptation, as in the previous project it was evident that this is a relatively new field of climate policy for most of the small municipalities.

The survey was conducted among all SMLA municipalities with less than 20,000 residents ($n = 1840$) in the German federal state of Bavaria. The key purpose was to detect the triggering and influencing factors in the development and installation of a local climate change mitigation and adaptation strategy and to identify current governance types and steering concepts. Particular attention was given to two aspects: firstly, the extent to which these factors can be influenced positively by appropriate governance; secondly, the stakeholders which therefore have to be involved. The survey was based on a questionnaire with 43 open and closed questions grouped into five thematic groups: perception of local climate change risks and adaptation responsiveness, fields of action and climate policies, triggering and influencing factors, responsibility for the political process and strategy implementation, and forms and levels of participation. All the questions within each thematic group were derived first from the literature and second out of the results of the predecessor project “C3-Alps”. A pretest of the draft questionnaire was done in two pilot municipalities and led to some minor improvements of the wording of some questions.

The data were collected through a self-inscription online questionnaire using the tool LimeSurvey [67]. The link to the questionnaire was sent by e-mail to the mayors’ offices together with a letter from the ministry requesting participation. The online survey was open for three weeks in October 2015. About 700 municipalities participated in the survey. A total of 401 completed questionnaires were collected, representing a response rate of 21%. The participating municipalities were spread all over Bavaria and represented a broad mixture in terms of size and financial capacity. Comparing the size distribution and spatial distribution with relation to the seven Bavarian NUTS II regions (see Table 1) in a chi-squared test, no significant differences can be confirmed at a 5% error level. The results can therefore be seen as representative of the entire territory of Bavaria. Nevertheless, in the sample, the small and especially very small municipalities were slightly underrepresented. The majority of the municipalities had between 2000 and 10,000 residents. Moreover, an analysis of the location of the participating municipalities on the map of Bavaria showed that there was no spatial concentration, not even along the rivers which caused heavy damage by flooding during the last decade.

Table 1. Sample structure concerning spatial distribution and population size.

Sample Structure			
	NUTS II	Bavaria	Sample
Spatial distribution of survey participants	Upper Bavaria	23.9%	29.6%
	Lower Bavaria	12.8%	13.7%
	Upper Palatinate	11.1%	12.5%
	Upper Franconia	10.5%	10.1%
	Middle Franconia	10.1%	9.4%
	Lower Franconia	15.2%	13.0%
	Swabia	16.4%	11.7%
	Pearson chi-square asymptotic significance 0.091		
Population size distribution of survey participants	Inhabitants	Bavaria	Sample
	Less than 2000	37.7%	33.8%
	2000 to 4999	37.9%	43.6%
	5000 to 9999	16.6%	15.6%
	10,000 to 19,999	7.8%	7.0%
	Pearson chi-square asymptotic significance 0.209		

In order to gain a better understanding of the structures and dependencies at the municipality level, the survey results were merged with official data from the statistical office of the Bavarian state. This allowed us to consider additional aspects in terms of population size, types of political structures in the council, the financial power or the level of debt in descriptive univariate and bivariate statistics and tests. Furthermore, a cluster analysis was carried out using K-MEANS clustering of SPSS 23 [68] which delivered results on the different climate change governance types that currently exist in Bavaria.

4. Findings and Discussion

The results of the survey provide an overview of the importance of climate change mitigation and adaptation as part of the political agenda in Bavarian SLMAs. In order to derive concrete recommendations for climate change policy, a specific look was taken at the framework conditions which directly influenced the process of planning and implementation of climate-change-related measures.

4.1. Perception of Local Climate Change Risks and Responsiveness to Adaptation

In a comprehensive literature review on climate change perception, Wolf and Moser [69] found a direct link between the level of engagement in climate change adaptation and the perception of climate change impacts. However, they also conclude that the awareness of potential risks or, even more, awareness of known negative impacts of climate change, does not necessarily always boost the willingness to adapt. The first section of our study therefore analyzed the perception and responsiveness at the municipality level. The questions were whether a municipality was already affected by climate change and whether climate change adaptation was an issue on the political agenda. In 60% of all cases it was clear that the municipality was affected. The most frequently reported events were heavy precipitation, flooding and drought. The remaining 40% did not feel affected, basing their perception either on the fact that no extreme events had ever occurred in their local areas, or that extreme events were nothing new but recurrent in local history and could therefore not be seen as a result of climate change. More than three-quarters (80%) of the municipalities had already put climate change adaptation on the political agenda, which means that 90% of the municipalities which felt affected by climate change were actively discussing it. Nevertheless, nearly two-thirds (64%) of the

municipalities that did not feel affected also discussed the topic of climate change policy. This shows a relatively high degree of willingness to contribute to mitigation as well as adaptation.

To date, one-fifth of the participating municipalities have not dealt with climate change adaptation in any way. Reasons they stated were: firstly, the conviction that they were not affected by climate change at all; secondly, even in cases where the municipality did see a need for discussion, the topic had not yet been on the agenda of local council meetings, or other problems were rated with higher priority. Finally, some argued that climate change was not one of the policy fields of small municipalities, or that there were no resources within their administration to deal with it.

4.2. Fields of Action and Climate Policies

The second section of the survey analyzed the fields of action and related measures. The literature review showed that the majority of the case studies into climate change policies at the municipal level primarily focused on the fields of water policy and the adoption of green technologies and infrastructure [41,70]. To gain a more detailed overview of the fields of action of small municipalities, we analyzed twelve climate policy fields. Some of them include matters which fall under the mandatory responsibilities of Bavarian municipalities (in accordance with the Bavarian constitution, articles 11 and 83). For each field, the municipalities were asked whether measures were already being discussed, and if so, to what extent they were being implemented. The results show that 52% of the municipalities have already started with the discussion and implementation of measures.

Table 2 shows that in total, energy-related topics head the list regarding the number of measures (in total, 672, representing a share of 40% of all measures), which could be seen as an indicator that climate change mitigation is given a higher implementation priority. A further result is the visible role of natural disasters and local flooding as a trigger for climate change adaptation, as measures in the field of the maintenance of waters and small rivers are also reported frequently (223 measures). Concerning policymaking at municipal level, the action field spatial and land-use planning is one of the most important of all: it determines the long-term development policy of each municipality and therefore also the long-term carbon footprint of its development. According to the German constitution, full responsibility for this field is explicitly devolved to the municipalities. However, the proportion of municipalities which see this field as a part of climate policy (31%) is low. In addition, the number of measures in this field being discussed or implemented clearly lags behind (107 reported measures). Furthermore, the results of Table 2 show that apart from the prevention of flooding (see line “maintenance of waters/small rivers”), the issue of adaptation is perceived as of secondary importance or rather neglected. Finally, it must be mentioned that about half of the reported measures have already been terminated (49%). The other half (51%) are still underway, either in discussion (12%), decided but not yet started (8%) or still running (31%). The overall picture shows a much higher priority in the field of mitigation. Campos et al. [50] made the same observation in their survey for Portuguese municipalities and stated that “lack of knowledge and information, lack of access to funding sources and the nature of mitigation versus adaptation actions may explain also why adaptation weighs less than mitigation”.

Table 2. Climate change relevant policy fields and level of discussion and implementation.

Field of Action	Mitigation (M) Adaptation (A) Both (M/A)	Small Municipalities with at Least One Measure in at Least One of the Fields of Action (<i>n</i> = 226)			Small Municipalities with at Least One Measure in a Specific Field of Action			
		% of Munici-Palities	Total Number of Measures Reported	Average Number of Measures per Municipality	% of Reported Measures Only Discussed	% of Reported Measures Decided but Not yet Started	% of Reported Measures with Running Implementation	% of Reported Measures with Closed Implementation
use of renewable energies	M	69%	306	1.9	12%	4%	19%	65%
energy-efficient renovation of public buildings	M	60%	275	2.0	9%	6%	21%	64%
maintenance of waters/small rivers	A	62%	223	1.6	12%	14%	32%	42%
public relation and consultation on climate protection	M/A	39%	193	2.2	9%	7%	48%	36%
public supply and disposal systems	M/A	31%	125	1.8	13%	9%	41%	38%
civil protection	A	36%	115	1.4	11%	2%	29%	59%
spatial and land-use planning	M/A	31%	107	1.5	25%	12%	36%	27%
support of energy efficiency investments	M	26%	91	1.5	10%	7%	42%	40%
road maintenance	A	24%	82	1.4	6%	11%	51%	32%
sustainable development of the transport sector	M	18%	79	2.0	12%	13%	28%	47%
protection of public buildings concerning climate variability	A	11%	33	1.4	14%	0%	20%	66%
other measures	M/A	10%	31	1.3	9%	18%	32%	41%

4.3. Triggering and Influencing Factors

A third research focus was the factors with positive or negative impact on the climate policy process concerning the starting point of discussion and the need for measures [71]. When asked to list events and factors with a positive impact on the discussion of climate change policy, only 17% of all municipalities gave an answer. The factors that were identified were (in order of descending importance): occurrence of extreme events, participation of civil society, participation of the municipality in climate alliances and networks, government funding programs related to climate change, the nuclear disaster of Fukushima, and private initiatives related to climate change. When asked to identify events and factors constraining the climate policy process, again, only few municipalities (19%) answered. These were (in order of descending importance): disapproval of planned measures by citizens, legal/financial/bureaucratic obstacles, lack of a clear assignment of responsibilities or obstacles to land acquisition (e.g., for retention areas). The diversity of supporting as well as constraining factors and events argues for individual processes in each municipality. Past natural disasters do not seem to play a major role. A further concern of the process analysis was the influence of characteristics of the municipality on the climate change policy process. The indicators to characterize the municipalities were the population size, the municipality tax revenues, the level of public debt, the leading political party's share of seats in the local parliament and finally the proportion of female deputies in the local parliament. The indicators used to describe the climate policy process were the number of fields of action addressed, the total number of reported measures and the average level of implementation of these measures. As all variables are quantitative, the Pearson correlation coefficient was used to find significant correlations. Furthermore, in a second step, a partial correlation analysis was carried out, measuring the influence of the different municipality characteristics on each other. Table 3 shows the results of the Pearson correlation coefficients.

Table 3. Correlation analysis municipality structure characteristics (columns) and policy process indicators (rows).

Correlation Analysis Structure Variables of Municipality Characteristics with Policy Implementation Indicators		Population Size	Tax Revenues	Public Debt	Share of Largest Political Group from All Seat in Local Parliament	Share of Female Deputies in Local Parliament
number of fields of action addressed	Pearson Correlation	0.253 **	0.225 **	0.205 **	−0.068	0.161 **
	Sig. (2-tailed)	0.000	0.000	0.000	0.181	0.002
total number of measures	Pearson Correlation	0.291 **	0.240 **	0.203 **	−0.112 *	0.186 **
	Sig. (2-tailed)	0.000	0.000	0.000	0.028	0.000
level of implementation	Pearson Correlation	0.155 *	0.059	0.007	0.029	−0.015
	Sig. (2-tailed)	0.024	0.389	0.922	0.678	0.832

** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Obviously, the population size has the highest and always a significant impact on all three climate policy indicators. Concerning the number of fields of action as well as the total number of measures, the tax revenues and public debt level also show significant correlations. Looking at the partial correlations of municipality structure characteristics and policy process indicators by using the population size as control variable, it is clear that the population size is the only real influence variable; partial correlations are no longer significant here because tax revenues as well as the level of public debt increase with the population size. While the political party structure of the local parliament shows hardly any influence on climate policy, the share of female deputies has a significant positive influence on the number of fields of action as well as on the total number of measures.

4.4. Responsibility for the Political Process and the Strategy Implementation

Despite the comprehensive research work on climate change mitigation and adaptation, the question of accountabilities and responsibilities at the local level has still not been answered sufficiently [72]. The authors therefore raised the questions as to, first, who discussed and decided the climate policy, and second, who was in charge of the implementation of the climate strategy that had been decided. Concerning the process leading to a climate policy (multiple options could be answered) the majority (77%) reported “the municipal council in public meeting”, followed by “municipal administration” (58%) and “local civil society” (32%). Again, the influence of the size of the municipalities on the policy process can be observed. While very small municipalities (under 2000 inhabitants) tend to have the discussion exclusively in their council, larger municipalities with 10,000 and more inhabitants develop their strategy based on all three pillars: administration (87%), council (61%) and civil society (57%). Concerning the implementation responsibility, first the “mayor” (67%) as the head of the administration and second the “municipal administration” (64%) were reported, while the “active civil society” did not play a role (13%). Concerning the implementation, the disparity between the very small municipalities and all the others is very evident: in the small municipalities, primarily the mayor (83%) and not the administration (33%) is seen as responsible, while in the larger municipalities it is exactly vice versa (mayor 33%, administration 83%).

4.5. Forms and Level of Participation

The relevance of multistakeholder governance by using external expertise and participation of the local community as a key principle in local climate change adaptation has been discussed in various national and international studies [41,52,73,74]. Therefore, forms and levels of participation in small municipalities, especially the involvement of external actors and citizens in the process of discussion, planning and implementation of climate policy and implementation, were a further concern of the survey.

Different types of external actors could be identified: specialists (such as engineers, architects or representatives of science and research), authorities from higher levels (such as federal ministries, regional authorities or bodies of the district administration) and nongovernmental organizations (especially environmental NGOs). To indicate the degree of involvement of each group, the respondents had to choose from five categories: (1) “involved in all actions”, (2) “involved in almost all actions”, (3) “partly involved”, (4) “involved in selected actions” or (5) “not involved”. Of the three groups of external actors, the specialists had the highest degree of involvement. Within this group, 63% of the respondents stated that specialists had been involved in all or almost all measures, mainly in the fields of “sustainable development of the transport sector” or “planning and construction”. Even though climate change has a direct link to environmental policy, NGO experts were only seldom involved. Only about a quarter (26%) of the respondents stated that NGOs were involved in all or almost all measures. The results showed that higher level authorities had a higher level of involvement in nearly all measures (49%). Concerning the degree of involvement, no significant differences between the different municipality size groups (see Table 1) could be observed (chi-squared test with maximal error level 5%).

Regarding the question of citizen participation, the respondents could select multiple answers evaluating the degree of participation: no participation, information, consultation, active participation, co-decision and ending with self-government [75]. In general, higher percentages were given to the lower forms of participation such as information (84%) and consultation (62%). Approximately a third (34%) offered their citizens active participation in open discussions or online forums. The more active forms of participation such as co-decision (5%) and self-government (8%) were only reported by a few municipalities.

4.6. Climate Policy and Governance Types

By conducting a cluster analysis [68] based on the above-mentioned results, a typology with five governance types could be identified, as characterized in Table 4.

Table 4. Climate policy and governance types of small municipalities in Bavaria.

Type		Focus	Level of Implementation	Processual Approach
pioneer	10%	Aspects of adaptation and mitigation have been dealt with.	At least two or more measures in all fields of action have been implemented. Adopted measures are implemented promptly.	Participation of citizens is on a lower level (information), but still of great importance.
hesitator	40%	Aspects of adaptation and mitigation have been dealt with.	Feasible measures have been only discussed on the political agenda, without practical implementation.	No need for participation yet as neither a strategy nor an implementation program exist.
energy specialist	24%	Aspects of mitigation are the priority topic. The focus lies on the fields of building refurbishment and renewable energies.	At least two or more measures have been implemented only in these fields. Other fields have been neglected.	A dialogue with citizens does not take place.
caretaker	13%	The main focus lies on issues which are linked to the topic of public services.	At least two or more measures have been implemented in the fields of public supply and disposal systems, renewable energies, maintenance of waters/small rivers. Other fields have been only discussed or neglected.	A dialogue with citizens does not take place.
energy-efficient dialogue partner	13%	Aspects of adaptation and mitigation have been dealt with, but the aspects of mitigation were given higher priority.	At least two or more measures have been implemented in the fields of public relation and consultation on climate protection, building renovation and renewable energies. Other fields have been only discussed or neglected.	A dialogue with and the information and consultation of citizens on the issues of climate change (both mitigation and adaptation) are important.

The “pioneer” has a comprehensive understanding of climate change and therefore is active in almost all issues of climate mitigation and climate adaptation. Pioneers take a leading role for other municipalities in how to integrate both mitigation and adaptation into the municipal processes and to pursue a cross-sectoral approach. Furthermore, they often provide special staff capacity to deal mainly or exclusively with the topic of climate change (e.g., climate manager). The low level of citizen participation indicates high efficiency in clear assignment of responsibilities within the municipal structures and in the involvement of special experts. It might be further assumed that citizens are overburdened by the complexity of climate change. The pioneers can primarily be found among municipalities with 5000 and more inhabitants, so they have the financial resources as well as the institutional capacity needed to deal with many topics at once. The administrations of the pioneers often include so-called climate managers or energy and climate consultants.

The “hesitator” is already aware of the issue of climate change and shows a political will to act. As no measures have been implemented yet, reasons might be seen in a lack of concrete concepts and instruments for acting step by step, or a lack of responsibilities and organizational structures. The next step towards initiating the implementation of measures in these municipalities would be to define clear responsibilities and prioritize fields of action. Hesitators are frequently found in the group of smaller municipalities (under 5000 inhabitants).

The “caretaker” has a rather sectoral competence. The maintenance of public infrastructure and implementation of general protective measures are the primary objectives of this type. Strategies are needed to follow a broader and more cross-sectoral approach on the topic of climate change, especially in the field of adaptation. A more intensive dialogue with citizens and local experts or gaining their support might help to identify the need for action and possible starting points. Especially small and very small municipalities are more often caretakers than those with larger populations.

Mitigation plays a crucial role on the political agenda of the “energy specialist” and “energy-efficient dialogue partner”. A higher share of energy specialists can be found in the smaller municipalities. Therefore, it may be assumed that they react to financial incentives and make use of the government

grants for energy efficiency investments. Special government programs might help to motivate this type to act in an anticipatory way in the concrete fields of adaptation. Like the caretaker, the energy efficient dialogue partners can be found among all municipalities, independent of their size.

5. Conclusions

Even though nearly half of the world population live in rural areas, research on climate policy at the municipality level primarily exists for larger cities, metropolises or the fast-growing megacities. To close the gap, this study provides a comprehensive analysis of the climate policy of small and medium-sized local authorities (SMLA) with populations of under 20,000 in Bavaria, Germany. The representative survey showed that climate change as a field for policy making has reached the agendas of 80% of the small municipalities in Bavaria. The reasons for putting the topic onto the political agenda are very varied, and experience of disasters induced by climate change does not play a significant role. Instead, the study found that the triggering factors for discussing climate change and taking the decision to define an individual municipality climate strategy are very individual. They are often the result of the engagement of one or a few persons. With regard to the implementation of mitigation and adaptation measures, we observed a significant gap between discussion and concrete action. Nearly half the SMLAs have not yet defined a policy linked with concrete measures. This deficit shows up especially for the very small municipalities with under 5000 inhabitants.

Concerning the responsibility for a climate policy at the municipality level, the local council was perceived as being in charge during the discussion and decision phase, while the administration and the mayors are seen as responsible for implementation. While SMLAs often make use of external experts or higher administrative levels, NGOs and civil society only take an active role in local climate policy in very few cases. Climate change is not seen as a concern of the entire local community and related bottom-up processes: while low-level participation types such as information and consultation are found quite frequently, the higher-level types such as co-decision or self-governance are rare in the field of climate change policy.

Furthermore, the typology of governance types showed that only a small number of SMLAs have a holistic approach to climate policy. These are, above all, the larger SMLAs. The others either specialize in one or similar fields of action, e.g., energy or public supply, or do not follow up the discussion with implementation. These hesitators are a large group and primarily come from very small or tiny municipalities with under 5000 inhabitants. This supports the results of Martins and Ferreira [12] stating that resources and capacities as well as institutions are needed for the implementation of a climate policy. Therefore, suitable policy approaches are needed to reduce this gap between being aware of climate change as a political issue and doing something about it. We saw that there is a significant correlation between the population size and the level of active involvement in climate policy. This implies that the very small and tiny municipalities feel unable to cope with such a complex policy field. Their adaptive capacity is too low to take concrete action.

A further result was that most of the municipalities only address one or a few fields of action. To raise climate policy from the single action level to a continuous and comprehensive approach is a second key challenge. There is no very simple solution of how to transfer climate policy to the next higher administrative and political level. According to the German and Bavarian constitutions, the fields of action listed in Table 2 are exclusively—or at least jointly—municipal responsibilities. Therefore, a policy framework specific to SMLAs is needed.

The research presented above leads the authors to recommend three instruments to overcome these deficits in municipality climate policy which shall be concretized with a more specific view to European SMLA and related proposals below:

- First, to increase awareness and reduce barriers to take climate change on the political agenda, as described by Shi et al. [76] and Suckall et al. [77], by municipality-level-tailored incentives;
- Second, installing a management structure to steady the capacity-building processes of discussion, learning and implementing, as proposed by Storbjörk [59];

- Third, mandatory integration of a climate strategy into the long-term local political agenda to support implementation and to avoid maladaptation or short-term actions.

It must be recognized that the implementation of measures is the most expensive part of mitigation and adaptation. As there are already a large number of funding programs to support measures in these fields, the key for holistic climate strategies is to create a link between these programs and the funding of single measures. This can be achieved by making a comprehensive climate strategy or local development plan which makes integrated climate change policy a mandatory part of funding applications in climate-change-related programs. In new funding application procedures, the municipality must also show how the specific measure fits into the entire strategy. An ex post funding of costs incurred in the development of the strategy could make such programs even more attractive.

The second pillar is the installation of climate change managers or a management unit at district or regional level. The management would have a role as expert pool as well as coordinators of a social learning process. As experts, they shall merge all municipality strategies and develop joint climate change strategies at district or regional levels. Parallel to this, they could advise, support and coordinate the municipalities in their work on capacity building in general but also to set up individual strategies at the municipality level. The management could close deficits in the fields of information, networking or management of all kind of measures touching interests of local community members. By this, it could take a central role to coordinate a social learning process within the administration but also in the local communities to increase the adaptive capacity of the policy system. A further positive side effect would be the relief of the mayors from operative tasks such as writing strategy papers, preparing tenders, or applying for funding.

A third and long-term very effective instrument is the mandatory integration of climate policy into land-use and settlement plans which are legally binding, often for decades. The ex-ante evaluation of the climate footprint (field of mitigation) as well as the expected climate-change-related vulnerability (field of adaptation) of the plans themselves have to be described and minimized. This climate-change-related analysis of the municipal territory and concrete local plans for mitigation, adaptation and prevention measures would fix a climate strategy for decades. As the consideration of climate change in land-use and settlement planning is a new instrument, the development and provision of an easy-to-apply, coherent and consistent methodology would be needed and should be provided at the federal state level. In the first years of this mandatory integration into the plans, funding of the planning costs could give a further boost to climate policy at the municipality level.

The study also showed the need for further research. On the one hand, the fact that the most frequently reported measures all came from fields which are highly subsidized in Germany and Bavaria suggest the influence of funding programs on the selection of climate change mitigation and adaption action fields. On the other hand, the responses of the municipalities in our survey did not confirm that funding played a role in triggering municipalities to take action. As our first policy recommendation is related to funding, this aspect needs to be analyzed further. A second field for research is the governance systems at the municipality level. We observed a very low level of integration of NGOs into the climate policy debates of SMLAs. In addition, we found that the level of external and citizen participation rarely went beyond information and consultation. This confirms the results presented by Thi Hong Phuong et al. [62], who investigated the role of social learning to increase the adaptive capacity of communities. Our survey design did not measure the attitude of the municipalities towards participatory processes, either in general or specifically in the field of climate change. This research gap needs to be closed in order to make further recommendations on designing local climate change response processes.

6. Limitation

Some limitations of this Bavarian case study must be mentioned. First, even though the response rate of the online survey was good and the distribution regarding population size and regional location were balanced, the outcome could be biased because the municipalities that were not willing to

participate in the study were very likely those that are not concerned with climate change. If this is the case, our results might exaggerate the picture.

Above all, it has to be stated that the political system in the European Union and its member states follow the principal of subsidiarity between the different administrative levels. This finally puts climate policy on the agenda within its specific responsibilities of each level defined by the state constitutions. The role of the municipalities therefore is always clearly defined, and the citizens expect that local policy-makers and administration take responsibility and action. Furthermore, the high level of welfare determines the fields for mitigation and adaptation to concentrate on infrastructure and services of public interest. Taking a global perspective, we recognize that climate change already today leads in many regions to existential threats. The real problems such as safeguarding food production or availability of drinking water lead to other adaptation processes which very often are initiated and steered by local communities outside of administrative systems.

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References

- Berman, R.; Quinn, C.; Paavola, J. The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. *Environ. Dev.* **2012**, *2*, 86–100. [[CrossRef](#)]
- Bulkeley, H.; Kern, K. Local Government and the Governing of Climate Change in Germany and the UK. *Urban Stud. Routledge* **2006**, *43*, 2237–2259. [[CrossRef](#)]
- United Nations. *World Urbanization Prospects—The 2014 Revision*; Department of Economic and Social Affairs of the United Nations Secretariat: New York, NY, USA, 2015.
- McCarthy, M.P.; Best, M.J.; Betts, R.A. Climate change in cities due to global warming and urban effects. *Geophys. Res. Lett.* **2010**, *37*, L09705. [[CrossRef](#)]
- Folberth, G.A.; Butler, T.M.; Collins, W.J.; Rumbold, S.T. Megacities and climate change—A brief overview. *Environ. Pollut.* **2015**, *203*, 235–242. [[CrossRef](#)]
- Dodman, D. Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories. *Environ. Urban.* **2009**, *21*, 203–224. [[CrossRef](#)]
- United Nations Paris Agreement for Implementing the United Nations Framework Convention on Climate Change 1992*; United Nations: Paris, France, 2016.
- European Council 2030 Climate and Energy Policy Framework*; European Council: Brussels, Belgium, 2014.
- Climate Action Plan 2050*; Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety: Berlin, Germany, 2016.
- China's Policies and Actions on Climate Change*; The National Development and Reform Commission: Beijing, China, 2014.
- Van, Z. Subsidiarity in European environmental law: A competence allocation approach. *Harv. Environ. Law Rev.* **2014**, *38*, 415–464.
- Martins, R.D.; Ferreira, L.D.C. Opportunities and constraints for local and subnational climate change policy in urban areas: Insights from diverse contexts. *Int. J. Glob. Environ. Issues* **2011**, *11*, 37. [[CrossRef](#)]
- Aguiar, F.C.; Bentz, J.; Silva, J.M.N.; Fonseca, A.L.; Swart, R.; Santos, F.D.; Penha-Lopes, G. Adaptation to climate change at local level in Europe: An overview. *Environ. Sci. Policy* **2018**, *86*, 38–63.
- Ryan, D. From commitment to action: A literature review on climate policy implementation at city level. *Clim. Chang.* **2015**, *131*, 519–529. [[CrossRef](#)]

15. Pielke, R.; Prins, G.; Rayner, S.; Sarewitz, D. Climate change 2007: Lifting the taboo on adaptation. *Nature* **2007**, *445*, 597–598. [[CrossRef](#)]
16. Satterthwaite, D. Climate change and urbanization: Effects and implications for urban governance. In Proceedings of the United Nations Expert Group Meeting on Population Distribution, Urbanization, Internal Migration and Development, New York, NY, USA, 21–23 January 2008; pp. 21–23.
17. Hoornweg, D.; Sugar, L.; Trejos Gomez, C.L. Cities and greenhouse gas emissions: Moving forward. *Environ. Urban.* **2011**, *23*, 207–227. [[CrossRef](#)]
18. Wright, L.; Fulton, L. Climate change mitigation and transport in developing nations. *Transp. Rev.* **2005**, *25*, 691–717. [[CrossRef](#)]
19. Rosenzweig, C.; Solecki, W.D.; Hammer, S.A.; Mehrotra, S. *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network*; Cambridge University Press: Cambridge, UK, 2011; ISBN 978-1-139-49740-4.
20. Fünfgeld, H. Facilitating local climate change adaptation through transnational municipal networks. *Curr. Opin. Environ. Sustain.* **2015**, *12*, 67–73. [[CrossRef](#)]
21. Corfee-Morlot, J.; Kamal-Chaoui, L.; Donovan, M.G.; Cochran, I.; Robert, A.; Teasdale, P.-J. Cities, climate change and multilevel governance. *OECD Environ. Work. Pap.* **2009**. [[CrossRef](#)]
22. Castán Broto, V.; Bulkeley, H. A survey of urban climate change experiments in 100 cities. *Glob. Environ. Chang.* **2013**, *23*, 92–102. [[CrossRef](#)] [[PubMed](#)]
23. Lidskog, R.; Elander, I. Addressing climate change democratically. Multi-level governance, transnational networks and governmental structures. *Sustain. Dev.* **2010**, *18*, 32–41. [[CrossRef](#)]
24. Campbell-Lendrum, D.; Corvalán, C. Climate Change and Developing-Country Cities: Implications for Environmental Health and Equity. *J. Urban Health Bull. N. Y. Acad. Med.* **2007**, *84*, 109. [[CrossRef](#)]
25. Holgate, C. Factors and Actors in Climate Change Mitigation: A Tale of Two South African Cities. *Local Environ.* **2007**, *12*, 471–484. [[CrossRef](#)]
26. Ramachandra, T.V. Shweta Decentralised carbon footprint analysis for opting climate change mitigation strategies in India. *Renew. Sustain. Energy Rev.* **2012**, *16*, 5820–5833. [[CrossRef](#)]
27. Revi, A. Climate change risk: An adaptation and mitigation agenda for Indian cities. *Environ. Urban.* **2008**, *20*, 207–229. [[CrossRef](#)]
28. Lankao, P.R. How do Local Governments in Mexico City Manage Global Warming? *Local Environ.* **2007**, *12*, 519–535. [[CrossRef](#)]
29. Barnett, J. Adapting to climate change: Three key challenges for research and policy—An editorial essay. *Wiley Interdiscip. Rev. Clim. Chang.* **2010**, *1*, 314–317. [[CrossRef](#)]
30. Biesbroek, G.R.; Klostermann, J.E.M.; Termeer, C.J.A.M.; Kabat, P. On the nature of barriers to climate change adaptation. *Reg. Environ. Chang.* **2013**, *13*, 1119–1129. [[CrossRef](#)]
31. Hunt, A.; Watkiss, P. Climate change impacts and adaptation in cities: A review of the literature. *Clim. Chang.* **2011**, *104*, 13–49. [[CrossRef](#)]
32. Clichevsky, N. Urban land markets and disasters: Floods in Argentina’s cities. *Build. Safer Cities* **2003**, 165–176.
33. Den Exter, R.; Lenhart, J.; Kern, K. Governing climate change in Dutch cities: Anchoring local climate strategies in organisation, policy and practical implementation. *Local Environ.* **2015**, *20*, 1062–1080. [[CrossRef](#)]
34. Curriero, F.C.; Heiner, K.S.; Samet, J.M.; Zeger, S.L.; Strug, L.; Patz, J.A. Temperature and mortality in 11 cities of the eastern United States. *Am. J. Epidemiol.* **2002**, *155*, 80–87. [[CrossRef](#)]
35. Dessai, S. Heat stress and mortality in Lisbon Part I. model construction and validation. *Int. J. Biometeorol.* **2002**, *47*, 6–12. [[CrossRef](#)]
36. Rosenzweig, C.; Major, D.C.; Demong, K.; Stanton, C.; Horton, R.; Stults, M. Managing climate change risks in New York City’s water system: Assessment and adaptation planning. *Mitig. Adapt. Strateg. Glob. Chang.* **2007**, *12*, 1391–1409. [[CrossRef](#)]
37. Wade, S.; Fenn, T.; Barnett, C. *Defra Research Contract: Climate Change Impacts and Adaptation—Cross Regional Research Programme (Project C—Water)*; Department for Environment, Food & Rural Affairs: London, UK, 2006.
38. Fuchs, R.; Conran, M.; Louis, E. Climate change and Asia’s coastal urban cities: Can they meet the challenge? *Environ. Urban. Asia* **2011**, *2*, 13–28. [[CrossRef](#)]
39. McGranahan, G.; Balk, D.; Anderson, B. The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. *Environ. Urban.* **2007**, *19*, 17–37. [[CrossRef](#)]

40. Nicholls, R.J. Coastal megacities and climate change. *GeoJournal* **1995**, *37*, 369–379. [[CrossRef](#)]
41. Boyd, E.; Juhola, S. Adaptive climate change governance for urban resilience. *Urban Stud. Sage Publ. Ltd* **2015**, *52*, 1234–1264. [[CrossRef](#)]
42. Bulkeley, H.; Tuts, R. Understanding urban vulnerability, adaptation and resilience in the context of climate change. *Local Environ.* **2013**, *18*, 646–662. [[CrossRef](#)]
43. Leichenko, R. Climate change and urban resilience. *Curr. Opin. Environ. Sustain.* **2011**, *3*, 164–168. [[CrossRef](#)]
44. Bulkeley, H.; Betsill, M.M. Rethinking sustainable cities: Multilevel governance and the “urban” politics of climate change. *Environ. Politics* **2005**, *14*, 42–63. [[CrossRef](#)]
45. Araos, M.; Berrang-Ford, L.; Ford, J.D.; Austin, S.E.; Biesbroek, R.; Lesnikowski, A. Climate change adaptation planning in large cities: A systematic global assessment. *Environ. Sci. Policy* **2016**, *66*, 375–382. [[CrossRef](#)]
46. Carlsson-Kanyama, A.; Carlsen, H.; Dreborg, K.-H. Barriers in municipal climate change adaptation: Results from case studies using backcasting. *Futures* **2013**, *49*, 9–21. [[CrossRef](#)]
47. Hung, H.-C.; Yang, C.-Y.; Chien, C.-Y.; Liu, Y.-C. Building resilience: Mainstreaming community participation into integrated assessment of resilience to climatic hazards in metropolitan land use management. *Land Use Policy* **2016**, *50*, 48–58. [[CrossRef](#)]
48. Berghammer, A.; Schmude, J. The Christmas–Easter shift: Simulating Alpine ski resorts’ future development under climate change conditions using the parameter “optimal ski day”. *Tour. Econ.* **2014**, *20*, 323–336. [[CrossRef](#)]
49. Trawöger, L. Convinced, ambivalent or annoyed: Tyrolean ski tourism stakeholders and their perceptions of climate change. *Tour. Manag.* **2014**, *40*, 338–351. [[CrossRef](#)] [[PubMed](#)]
50. Granberg, M.; Elander, I. Local Governance and Climate Change: Reflections on the Swedish Experience. *Local Environ.* **2007**, *12*, 537–548. [[CrossRef](#)]
51. Aall, C.; Groven, K.; Lindseth, G. The Scope of Action for Local Climate Policy: The Case of Norway. *Glob. Environ. Politics* **2007**, *7*, 83–101. [[CrossRef](#)]
52. Dannevig, H.; Rauken, T.; Hovelsrud, G. Implementing adaptation to climate change at the local level. *Local Environ.* **2012**, *17*, 597–611. [[CrossRef](#)]
53. Dannevig, H.; Aall, C. The regional level as boundary organization? An analysis of climate change adaptation governance in Norway. *Environ. Sci. Policy* **2015**, *54*, 168–175. [[CrossRef](#)]
54. Measham, T.G.; Preston, B.L.; Smith, T.F.; Brooke, C.; Gorddard, R.; Withycombe, G.; Morrison, C. Adapting to climate change through local municipal planning: Barriers and challenges. *Mitig. Adapt. Strateg. Glob. Chang.* **2011**, *16*, 889–909. [[CrossRef](#)]
55. Campos, I.; Guerra, J.; Gomes, J.F.; Schmidt, L.; Alves, F.; Vizinho, A.; Lopes, G.P. Understanding climate change policy and action in Portuguese municipalities: A survey. *Land Use Policy* **2017**, *62*, 68–78. [[CrossRef](#)]
56. Brooks, N.; Adger, W.N.; Kelly, P.M. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Glob. Environ. Chang.* **2005**, *15*, 151–163. [[CrossRef](#)]
57. Gallopín, G.C. Linkages between vulnerability, resilience, and adaptive capacity. *Glob. Environ. Chang.* **2006**, *16*, 293–303. [[CrossRef](#)]
58. Smit, B.; Wandel, J. Adaptation, adaptive capacity and vulnerability. *Glob. Environ. Chang.* **2006**, *16*, 282–292. [[CrossRef](#)]
59. Storbjörk, S. ‘It Takes More to Get a Ship to Change Course’: Barriers for Organizational Learning and Local Climate Adaptation in Sweden. *J. Environ. Policy Plan.* **2010**, *12*, 235–254. [[CrossRef](#)]
60. Glaas, E.; Jonsson, A.; Hjerpe, M.; Andersson-Sköld, Y. Managing climate change vulnerabilities: Formal institutions and knowledge use as determinants of adaptive capacity at the local level in Sweden. *Local Environ.* **2010**, *15*, 525–539. [[CrossRef](#)]
61. Johannessen, Å.; Hahn, T. Social learning towards a more adaptive paradigm? Reducing flood risk in Kristianstad municipality, Sweden. *Glob. Environ. Chang.* **2013**, *23*, 372–381. [[CrossRef](#)]
62. Thi Hong Phuong, L.; Biesbroek, G.R.; Wals, A.E.J. The interplay between social learning and adaptive capacity in climate change adaptation: A systematic review. *NJAS Wagening. J. Life Sci.* **2017**, *82*, 1–9. [[CrossRef](#)]
63. Schwarzak, S.; Joneck, M. *Bayerisches Landesamt für Umwelt (LfU). Bayerische Klima-Anpassungsstrategie 2016*; Bayerisches Staatsministerium für Umwelt und Verbraucherschutz: Munich, Germany, 2017.
64. Austrian Environmental Agency. *Capitalising Climate Change Knowledge for Adaptation in the Alpine Space*; Alpine Space Programme: Wien, Austria, 2015.

65. Bausch, T.V.; Scheibel, C.; Hörmann, F. *Climate Check*; Munich University of Applied Sciences: München, Germany, 2014.
66. Climate Change Governance. *Climate Change Management*; Knieling, J., Leal, W.L., Eds.; Springer: Berlin, Germany, 2013; ISBN 978-3-642-29831-8.
67. LimeSurvey Manual. 2020. Available online: https://manual.limesurvey.org/LimeSurvey_Manual (accessed on 30 January 2020).
68. Sarstedt, M.; Mooi, E. Cluster Analysis. In *A Concise Guide to Market Research*; Springer: Berlin, Germany, 2014; pp. 273–324.
69. Wolf, J.; Moser, S.C. Individual understandings, perceptions, and engagement with climate change: Insights from in-depth studies across the world. *Wiley Interdiscip. Rev. Clim. Chang.* **2011**, *2*, 547–569. [[CrossRef](#)]
70. Karpouzoglou, T.; Dewulf, A.; Clark, J. Advancing adaptive governance of social-ecological systems through theoretical multiplicity. *Environ. Sci. Policy* **2016**, *57*, 1–9. [[CrossRef](#)]
71. Schröder, C.; Walk, H. Local Climate Governance and the Role of Cooperatives. In *Climate Change Governance*; Springer: Berlin/Heidelberg, Germany, 2013; pp. 105–118.
72. Birkmann, J.; Garschagen, M.; Setiadi, N. New challenges for adaptive urban governance in highly dynamic environments: Revisiting planning systems and tools for adaptive and strategic planning. *Urban Clim.* **2014**, *7*, 115–133. [[CrossRef](#)]
73. Wyborn, C. Co-productive governance: A relational framework for adaptive governance. *Glob. Environ. Chang.* **2015**, *30*, 56–67. [[CrossRef](#)]
74. Munaretto, S.; Siciliano, G.; Turvani, M.E. Integrating adaptive governance and participatory multicriteria methods: A framework for climate adaptation governance. *Ecol. Soc.* **2014**, *19*, 74. [[CrossRef](#)]
75. Müller, E.; Stotten, R. *Public Participation Manual*; Lucern University of Applied Sciences and Arts—Social Work: Luzern, Switzerland, 2012.
76. Shi, L.; Chu, E.; Debats, J. Explaining Progress in Climate Adaptation Planning Across 156 U.S. Municipalities. *J. Am. Plann. Assoc.* **2015**, *81*, 191–202. [[CrossRef](#)]
77. Suckall, N.; Tompkins, E.; Stringer, L. Identifying trade-offs between adaptation, mitigation and development in community responses to climate and socio-economic stresses: Evidence from Zanzibar, Tanzania. *Appl. Geogr.* **2014**, *46*, 111–121. [[CrossRef](#)]



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