sustainability

MDPI

Article

Fostering Self-Protection against Impacts of Heavy Rain at the Municipal Level

Jana Lorena Werg [1,*], Torsten Grothmann [2] and Stefan Löchtefeld [3]

[1] Department of Geography, Humboldt-University Berlin, 10117 Berlin, Germany
[2] Ecological Economics Group, Department of Business Administration, Economics and Law, Carl von Ossietzky University of Oldenburg, 26129 Oldenburg, Germany; torsten.grothmann@uni-oldenburg.de
[3] e-fect eG, 10437 Berlin, Germany; loechtefeld@e-fect.de
* Correspondence: jana.werg@hu-berlin.de; Tel.: +49-30-234-686-57

Abstract: Local governments are highly relevant actors when it comes to mitigating climate change impacts such as flooding. Not only do they need to implement regulatory and infrastructural measures, but they also need to promote complementing self-protective measures at the household level. The individual motivation of municipal actors to pursue climate adaptation can be important for the implementation of such measures, obviously alongside several other factors, such as financial and administrative issues. A questionnaire survey with a non-random sample of 77 local government actors from 15 of the 16 German federal states was conducted, focusing on potential key factors concerning the motivation to implement adaptation measures against hazardous impacts of heavy rain. Additionally, the perceived effectiveness and realizability of selected municipal structural measures and of activation measures promoting self-protective behavior were collected. It can be shown that the perceived realizability of adaptation measures as well as knowledge of risk and adaptation may be key factors in the motivation to implement both activation and structural measures, while motivation and implementation are only partially related. The results imply a need for the evaluation of activation measures and a need for further research on the motivation of municipal actors to implement activation measures.

Keywords: heavy rain; weather extremes; climate change; adaptation; municipality; household level; self-protection; perception

Citation: Werg, J.L.; Grothmann, T.; Löchtefeld, S. Fostering Self-Protection against Impacts of Heavy Rain at the Municipal Level. *Sustainability* **2021**, *13*, 7019. https://doi.org/10.3390/su13137019

Academic Editor: Valentina Palermo

Received: 11 May 2021
Accepted: 16 June 2021
Published: 22 June 2021

1. Introduction

In Germany, insured losses due to heavy rain events amounted to 2.6 billion Euros in the year 2018 alone [1]. According to German municipalities, heavy rain [2] has been the number one negative impact of different extreme weather events [3]. Damages caused by heavy rain events range from damages to property and infrastructure to significant environmental damage (e.g., land erosion, contamination) and loss of lives [4]. Furthermore, extreme weather events such as heavy rain will likely increase due to climate change [5].

The growing importance of adapting to those events and trends is reflected at the political level. Since 2008, the German Strategy for Adaptation to Climate Change (DAS) has been the political background to promoting and supporting climate change adaptation in municipalities all over Germany [3]; also, the German Working Group on water issues of the Federal States and the Federal Government (LAWA) developed a strategy for the effective management of heavy rain events [6], to name only a few. In these strategies, local governments are considered highly relevant actors when it comes to coping with (regionally, very different) climate change impacts and implementing the recommendations of national adaptation strategies such as the DAS [7,8]. At the same time, local governments are under considerable strain to adapt to increasingly extreme weather events, such as heavy rainfall, and their potential impacts [9]. Structural measures at the municipal level, such as flood detention basins or the unsealing of surfaces, are essential yet often not

sufficient to prevent severe damages caused by rare extreme events [4], making (additional) self-protective measures by private households, such as the elevation of entrances or the installation of backflow flaps, indispensable [10]. Consequently, the progress report of the German Strategy for Adaptation to Climate Change (DAS) incorporates the goal of self-protection and self-initiation by private households [11].

In short, municipal actors need both to implement structural measures and activate private households to contribute to averting negative impacts from heavy rain events. There have been several attempts to categorize different municipal measures with regard to adapting to heavy rain events (for an overview, see [4]). To simplify matters, we will from now on refer to structural measures (meaning regulative or structural measures financed and implemented at the municipal level) and activating measures (meaning measures that aim at activating private households to implement self-protective measures).

There are different angles from which to look at the implementation—and possible barriers to the implementation—of structural measures and activating measures: Hasse and Willen [3] offer an overview of the level of climate change adaptation and types of measures that have been implemented over the past years in German municipalities. They report that up to 60% of them do not have any formal/governance tools for climate adaptation nor do they aspire to implement such tools [3], yet 74% of the 249 municipalities included in their study had already implemented climate adaptation measures or were planning to do so—the majority of measures relating to urban-land-use planning and water management (ibid. pp. 14–15). Schüle et al. [12] describe key factors to successful systematic climate change adaptation by municipalities which relate to the main barriers of implementation. Besides actual past exposure to extreme weather events, they found that a municipality's economic structure and its dynamics, the administrative organization and cross-sectoral cooperation culture, and the level of experience of climate change adaptation to be essential to the implementation of climate adaptation measures (also see [13–15]). Hasse and Willen [3] identify a lack of acceptance of climate adaptation measures within (municipal) administrations as another important barrier to their implementation.

Another factor considered key to successful implementation of adaptation measures is citizen participation in flood risk management (FRM) [16], and it can be seen that citizens across Europe are increasingly expected to engage in self-protective behavior to protect themselves from flood damage [17]. This typically involves participating in volunteer activities aiming at enhancing general municipal preparedness [18–20]. However, we still need to understand fully whether, or to which extent, the goal of fostering self-protective measures can actually be accomplished through participation processes or rather specific activating measures within such processes [21]. In fact, several studies reflecting on citizen participation in climate adaptation processes in Germany can be found (see [21–27]). However, the question of whether these participation processes could actually increase the participants' motivation to implement self-protective adaptation measures was not systematically evaluated, only touched upon at the most. Grothmann and Michel [22] report on the evaluation of this behavioral effect of citizen participation processes in four German cities (including data from Born et al. [10]): The events were effective in so far as they increased the participants' motivation for self-protection, but mostly only among less than half of the participants. Many reports only marginally elaborate on activation measures or leave the subject aside (cf. [3,28]).

Therefore, the systematic evaluation of the impact of specific activation measures is much needed. However, the evaluation of the impact of activation measures on the actual implementation of self-protective measures would require long-term and complex studies. Following the approach taken by Grothmann and Michel [22] and Born et al. [10], evaluating the impact of activation measures on factors relevant for private households in taking self-protective measures seems reasonable. Such approaches were able to draw on well-founded knowledge about self-protection against impacts of heavy rain: Past research showed that several psychological and socio-demographic factors play a role as to whether or not citizens implement self-protective measures [21,29,30]: They range

from risk perception [31], the assessment of one's own ability to adapt [31,32], knowledge about potential risks and measures [33], perceived social norms [34], or the existence of role models (i.e., comparable households that have already implemented self-protective measures) [35–37]. For a more extensive reflection on factors relevant to self-protection, see Valkengoed and Steg [30], Bamberg et al. [38], Grothmann [21], and Werg et al. [29,39]. Such knowledge provides a solid basis for the systematic evaluation of the impact of activation measures on key factors for self-protection.

Alongside the described need for evaluation, there is a need for improving knowledge about the municipal actors who are potentially capable of implementing activation measures: Due to a complex set of uncertainties (climatic, financial, regulatory, administrative issues), municipalities are often still reserved when it comes to implementing climate adaptation measures [12,40]. For municipalities that have already implemented adaptation measures, it can be shown that it is often one specific person within the administration who picks up and presses ahead the issue of climate adaptation [12]. At the same time, decision-making in public administrations on the implementation of climate adaptation measures, and in general as well, is, to a very large extent, influenced by other factors than the motivation of single individuals (see the above description of key factors) [12,41]. It can be assumed that such key factors in turn also shape the perceptions, attitudes, and, ultimately, decision-making of the individuals working in public administration (cf. Figure 1), making them even more relevant. Nevertheless, looking at individual municipal actors, their perceptions, and the way in which these factors potentially influence their motivation to take adaptation action seems to be a promising new perspective for a more comprehensive understanding of municipal climate adaptation. This is underlined by the important role of single persons in picking up and pressing ahead the issue of climate adaptation within a municipal administration, as shown by Schüle et al. [12].

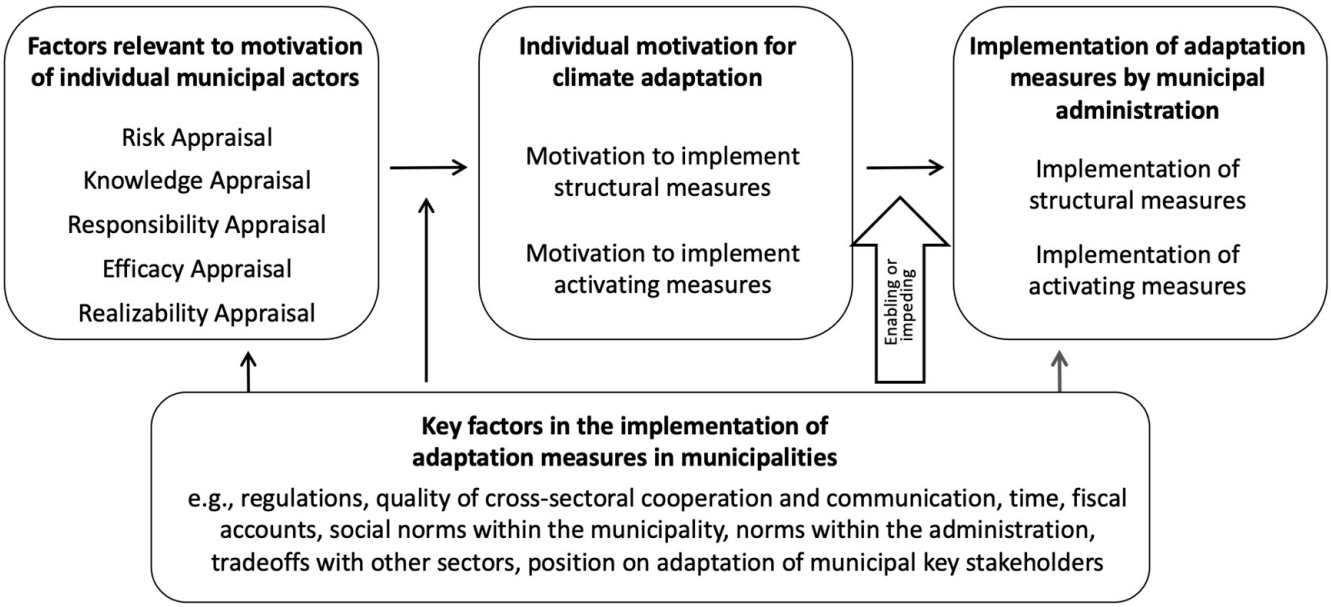

Figure 1. Factors potentially relevant to the motivation of municipal actors to implement adaptation measures and their potential relation to implementation (own illustration).

It seems crucial to learn more about the perceptions of municipal actors concerning adaptation measures and the possible correlation of these perceptions with the motivation to actually implement such measures. Such insights could help in providing municipal actors with the information they need and to design, e.g., transdisciplinary workshops and projects, along psychological factors found key to foster the motivation of municipal actors to implement adaptation measures—thereby ideally increasing this motivation. For this research, the following factors were assumed to be relevant to the motivation

of municipal actors to implement activating and structural measures: the appraisal of heavy rain risks in their municipality, of the effectiveness and realizability of activating and structural measures, and of their perceived responsibility to implement such measures, as well as their knowledge of risks and potential adaptation measures (see Figure 1). This assumption was based on well-founded knowledge of psychological factors relevant to private households taking self-protective actions to prevent losses caused by heavy rain events (see above), basically looking at municipal actors as individuals whose decision-making processes in their professional life may be influenced by the same psychological mechanisms and factors that have been proven to influence and shape decision-making and the behavior of individuals in private households, hence in their private life. Consequently, the research questions were:

1. What is the current degree of municipal actors' risk appraisal, perceived (collective/self) efficacy, and knowledge about adaptation measures?
2. How do municipal actors dealing with heavy rain adaptation assess the effectiveness and realizability of selected structural measures and activating measures?
3. How motivated are the municipal actors to implement activation and structural measures?
4. What is the self-assessed implementation status of these measures in their municipality?
5. How do their levels of risk appraisal, perceived efficacy, and knowledge correspond with their motivation to implement structural and activating measures?
6. To what extent does the individual motivation to implement measures correspond with the assessed status of implementation within a particular municipality?

Questions 1–5 focus on the left side of the illustration (Figure 1), i.e., focus on developing an understanding of which factors may be relevant in the forming of the individual motivation to implement climate adaptation measures, being aware that this can only be a small contribution to depicting the complex path to the actual implementation by the municipal administration. Question 6 aims at understanding how individual motivation and implementation in a municipality might be interrelated, while being aware of the stark limitations of such an interrelation (see above).

2. Materials and Methods

2.1. Survey Method and Sample

An online survey was conducted in June and July 2019. Table 1 shows the operationalization of the dependent and independent variables. The different independent variables were assumed to have an influence on the dependent variables, i.e., the motivation of individual municipal actors to implement measures and, with many constraints (see above), the (assessed) status of implementations. Answer categories were strongly agree; agree; slightly agree; slightly disagree; disagree; strongly disagree; do not know. For a complete overview of all items included in the survey and the according results, refer to Table S1 in the Supplementary Material. All items were developed in an iterative survey design process within a team of researchers involved in a project with the aim of evaluating communication formats fostering self-protection against impacts from heavy rain at the household level. This included three cycles of developing a prototype of the questionnaire based on our literature research (see below), running the questionnaire by team members with both a scientific and practical understanding of municipal climate change adaptation, and discussing their feedback on the inclusion of further items and on the improvement of how to phrase the items for better understandability.

Table 1. Variables included in the survey. Assumed direction of influence indicated in brackets.

Variable	Operationalization
INDEPENDENT VARIABLES	
Risk appraisal (R1–R2)	
R1. Risk experience appraisal (+)	My municipality has already been affected by heavy rain events in the past.
R2. Future risk appraisal (+)	My municipality will be strongly affected by heavy rain events in the upcoming years.
Efficacy appraisal (E1–E4)	
E1. Perceived efficacy of department (+)	My department (work area) can initiate effective protective measures regarding heavy rain/flooding.
E2. Perceived collective efficacy (+)	Through joint action (government/citizens) we can implement effective measures against damage from heavy rain/flooding in our municipality.
E3. Perceived efficacy of self-protective measures by private households (+ activation)	Activating private households to undertake self-protective measures, I think is very effective for preventing damages from heavy rain.
E4. Perceived efficacy of structural measures (also to protect households) (− activation)	Protective measures against heavy rain/flooding by governmental actors are sufficient also to protect private households from flood-related damages.
Realizability appraisal (F1)	
F1. Perceived realizability of activating private households (+ activation)	Activating private households to undertake self-protective measures, I think is very realizable by my work department.
Responsibility appraisal (Res1–Res2)	
Res1. Perceived governmental responsibility (+ structural; − activation)	It is mainly with the responsibility of governmental bodies to implement measures against heavy rain/flooding.
Res2. Perceived private responsibility (+ activation)	Private households are also highly responsible to implement measures against heavy rain/flooding.
Knowledge appraisal (K1–K2)	
K1. Perceived risk knowledge (+)	I have extensive knowledge regarding the potential threats to my municipality by heavy rain events.
K2. Perceived adaptation knowledge (+)	I have extensive knowledge regarding my department's (work area) possibilities to foster/implement protection against heavy rain/flooding.
DEPENDENT VARIABLES (D1.1–D2.2)	
D1.1 Individual motivation activation	I am motivated to implement measures with my work department aiming at the activation of private households for taking self-protective measures.
D2.1 Individual motivation structural measures	I am motivated to implement regulative or structural measures for avoiding damage from heavy rainfall at the municipal level with my work department.
D1.2 Municipal implementation activation	In my municipality many measures aiming at the activation of private households for taking self-protective measures have already been implemented.
D2.2 Municipal implementation structural measures	In my municipality many heavy-rainfall-related regulative or structural measures for avoiding damage from heavy rainfall have already been implemented.

For the specific activation and structural measures to be included in the survey, we collected a variety of well-known measures of both types based on publications on this topic [4,10,21,42–45] but only included precautionary adaptation measures, excluding reactive measures, such as immediate action in reaction to the onset of a heavy rain event [29]. The measures finally included in the research are listed in Table 2. It seemed appropriate to include a wide range of activating measures given that, despite the goal of the DAS to activate private households to implement self-protective measures, the issues of self-protection, and how to promote self-protection, have been mostly neglected. Moreover, the issues did not get much attention in reports dealing with the impact of

the DAS, and they belonged to the least-known and least-implemented principles when German municipal actors were asked about principles of the DAS [3].

Table 2. Structural and activation measures included in survey.

Activating Measures *	Structural Measures
ACT1. Model houses regarding heavy rain events: Activation of selected private households in different neighborhoods that implement exemplary self-protective measures ACT 2. Hazard maps for heavy rain events, showing citizens whether their property is within an area at risk of flooding ACT 3. Indicating areas at risk in heavy rain events in land-use plans. ACT 4. Charts indicating responsibilities as to planning/municipal precautions and self-protection. ACT5. Flood pass: Risk assessment of private property including information on self-protective measures ACT6. Information brochures for private households, including information on heavy-rain-related risks and self-protective measures ACT7. Information brochures for those authorized to present building documents, encouraging the promotion of self-protective measures when in touch with house builders ACT8. Municipal consultation, offering citizens information on potential risks and self-protective measures. ACT9. Standards for house builders in development areas (e.g., regarding sealing) ACT10. Standards for the owners of existing buildings to install backflow flaps ACT11. Photographic documentation of past regional flood damages ACT12. Higher standards in reconstruction or expansion plans for existing buildings and for new buildings	STRUC1. De-central infiltration and evaporation STRUC2. Central infiltration STRUC3. Protection of and creation of retention areas STRUC4. (Partial) unsealing of sealed surfaces STRUC5. Retention of discharge peaks in or on buildings in water reservoirs STRUC6. Multifunction use of traffic areas and open spaces (rain detention) STRUC7. Greening of rooftops STRUC8. Construction of detention basins STRUC9. Reactivation of former ditches and watercourses STRUC10. Above-ground drainage of rainwater STRUC11. Emergency drainage via streets and walkways STRUC12. Avoiding discharge of rainwater from agricultural areas into sewage water system and residential areas STRUC13. Systematic drainage of runoff water in the outskirts of the community and erosion protection STRUC14. A concept for water sensitive planning and development tailored to the municipals' needs, serving as a guideline for action by municipal actors. STRUC15. Legally binding standards for the Town and Country Planning Code

* Measures based on monetary incentives such as the financial support of structural modifications to climate adaptation measures regarding heavy rain events were not included in the survey due to their rare use [46].

The invitation to participate in the survey was sent, nationwide, to 450 publicly available email addresses of municipal actors from municipal governments (urban planning and environmental planning) and municipal enterprises (wastewater) in Germany, considered key actors in climate adaptation [3]. The invitation included the request to forward the invitation to other relevant persons from the recipients' work fields at the risk of cross-postings. At 17.11%, the response rate of the survey was rather low, which will be addressed in the discussion. In total, 77 municipal actors from 15 federal states participated in the survey, of which 63.6% were male, 35.1% female, and 1.3% did not reveal a binary gender. The population of the respondents' areas of responsibility (e.g., municipality, administrative district) ranged from 13,000 to 4.5 m inhabitants. In addition, 79.2% of the respondents were employees of municipal administrations, 20.8% of municipal enterprises. Areas of responsibility were: 42.9% "environment", 29.9% "wastewater", 14.3%, "planning", and 13.0% "other areas". "Other areas" were (open answers): fire and emergency management (1.3%), fire service (1.3%), climate adaptation (1.3%), climate protection (2.6%), climate protection and climate adaptation (1.3%), construction and maintenance of roads including drainage (1.3%), traffic infrastructure (1.3%), and water management (2.6%).

2.2. Steps of Data Analysis

Several descriptive statistics were generated in order to get an overview over the features of the data, such as a general idea of how structural measures are perceived compared to activation measures. Correlation analyses (Pearson's r) as well as simple linear regression analyses for each variable were conducted to understand the relation of the independent and dependent variables.

To control for potential problems associated with multicollinearity [47,48], we examined the correlation matrix of all independent variables: There was no correlation higher

than 0.70. The highest correlation occurred between the variables R1 Risk experience appraisal and R2 Future risk appraisal with r = 0.43 ($p < 0.01$). We carried out multiple linear regressions (entry method "enter") for each dependent variable to ascertain the extent to which the independent variables can predict the individual motivation of implementing activating measures (D1.1)/individual motivation of implementing structural measures (D2.1) and the perceived status of implementation of according measures (D1.2, D2.2) in the municipality, feeding all variables into the respective models that showed significant R2 values in the simple regressions.

3. Results

In the following, the results of the survey are elaborated on along the research questions specified in the introduction.

3.1. Degree of Past Experiences Regarding Heavy Rainfall, Respondents' Risk Perception, Perceived Efficacy, and Risk and Adaptation Knowledge

The bar plot in Figure 2 shows the results for all independent variables. Each bar indicates the level of agreement with the statements operationalizing the variables (for a complete list of statements, see Table S1 in the Supplementary Material). Levels of agreement ranged from strongly agree to strongly disagree on a six-point scale.

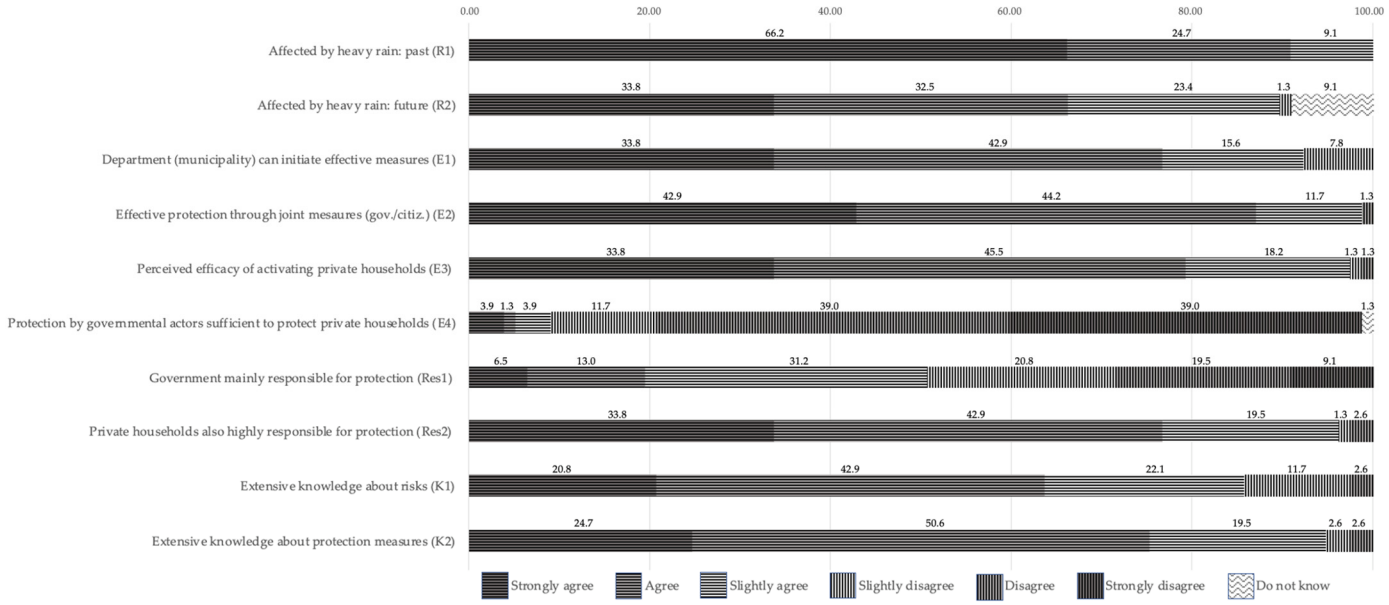

Figure 2. Results for all independent variables (agreement with statements operationalizing the variables in percentages); n = 77.

In accordance with results from other studies [3], a large majority of respondents state that their community had been affected by heavy rain in the past (R1) and assume that their municipality will be strongly affected in the future (R2), while also assuming that it is possible to implement effective protective measures (E1). At the same time, only very few of the respondents consider municipal measures sufficient also to protect private households (E4), and a large majority agree that activating private households is very effective in preventing damages (E3). Finally, a large majority agree that citizens and governmental actors can implement effective measures against heavy rain/flooding through joint action (E2). This is in line with the perception concerning the accountability for taking protective measures: Less than half of the respondents agree that it is mainly within the responsibility of governmental bodies to implement measures against heavy rain/flooding (Res1), while a large majority agree that private households are also highly responsible to implement measures against heavy rain/flooding (Res2).

A lack of knowledge concerning climate-related risks and according adaptation measures does not seem to be an issue as perceived by the respondents: A large majority agree that they have extensive knowledge regarding the potential threats to their municipality by heavy rain events (K1) and that they also have extensive knowledge regarding the possibilities of implementing protection against heavy rain/flooding (K2).

3.2. Assessment of the Effectiveness and Realizability of Structural Measures and Activating Measures

Figure 3 depicts the mean values of the assessed effectiveness and realizability of the included structural measures and activation measures as listed in Table 2 (for a complete list of measures and their assessment, see Supplementary Material Table S1). The dots' values in Figure 3 represent mean values of agreement/disagreement (from 1 = strongly disagree to 6 = strongly agree) to statements regarding the effectiveness (*x*-axis) and realizability (*y*-axis) of activation and structural measures. It can be seen that structural measures are generally assessed to be both more effective (mean: 4.88 vs. 2.03) and easier to implement (realizability, mean: 3.29 vs. 2.51) than activation measures—with the exception of G12 Higher standards in (re)construction, being assessed as quite realizable (mean: 3.11) yet not very effective (mean: 1.82). Among the activation measures, two other measures stand out: The measure G1 Model houses regarding heavy rainfall events is assessed as being the most realizable (mean: 3.56) while also being assessed as relatively effective for a measure of its category (mean: 2.34); the measure G11 Photographic documentation of past regional flood events is assessed as the most effective in its category (2.66), with its assessed realizability being only slightly above average (mean: 2.39).

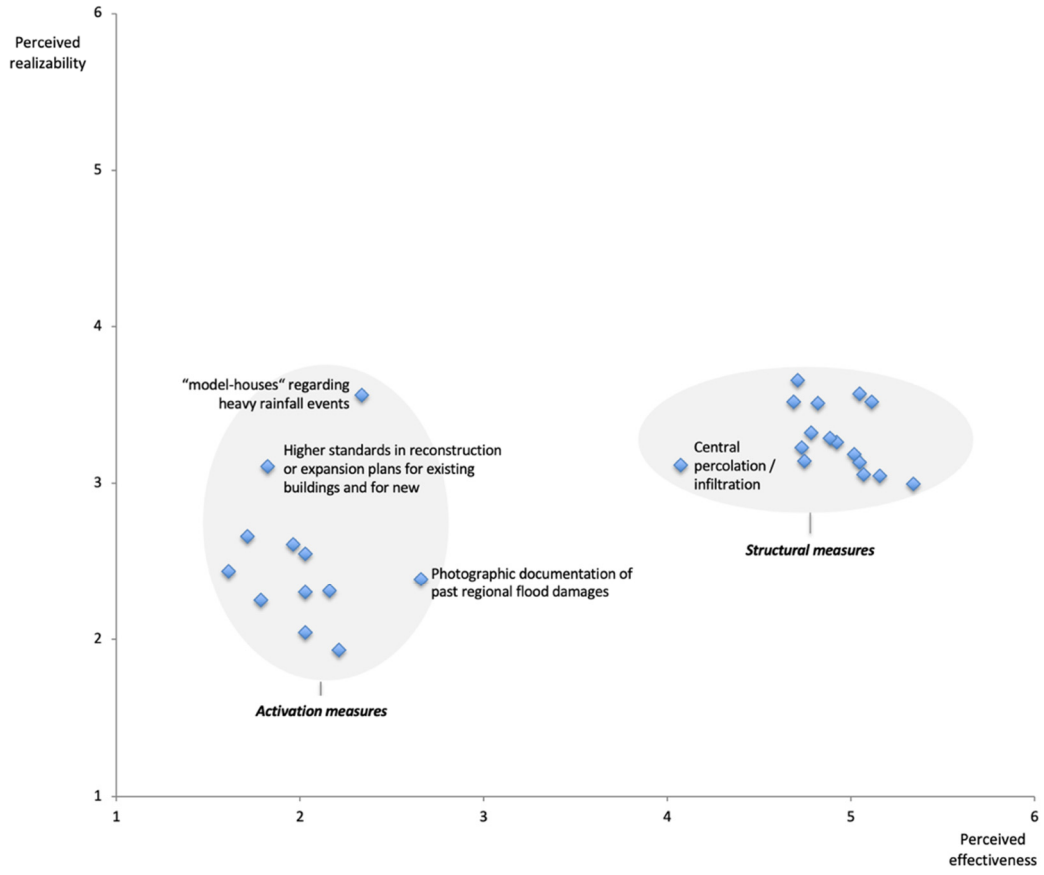

Figure 3. Perceived realizability and perceived effectiveness of measures listed in the questionnaire; n = 77.

3.3. Motivation to Implement Structural and Activating Measures, Assessed Status of Implementation of Structural and Activating Measures, and Correspondence between Motivation and Implementation

The bar plot in Figure 4 shows the results for all dependent variables. Each bar indicates the level of agreement with the statements, operationalizing the variables (for a complete list of statements, see Table S1 in the Supplementary Material). Levels of agreement ranged from strongly agree to strongly disagree on a six-point scale.

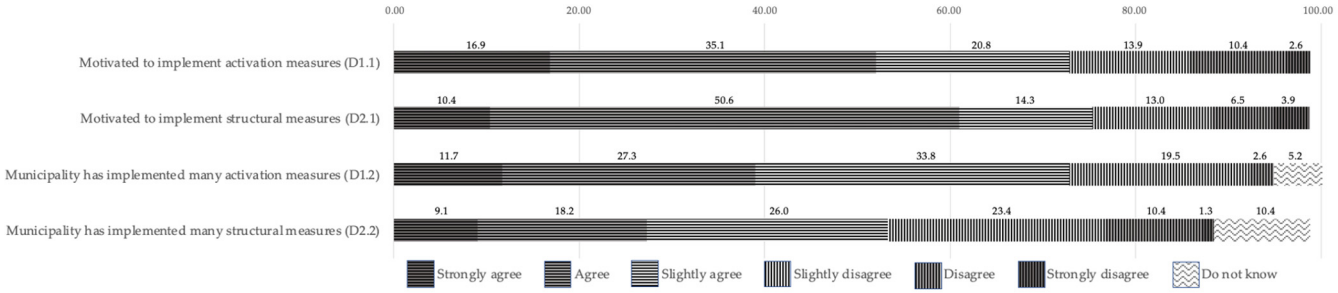

Figure 4. Results for dependent variables (agreement with statements, operationalizing the variables in percentages); n = 77.

More than two-thirds of the respondents agree that they are motivated to implement structural measures with their work department (D2.1). Almost as many of the respondents agree with the statement that they are motivated to implement activation measures (D1.1). Moreover, the majority of the respondents agree that many structural measures (D2.2) and many activation measures (D1.2) have already been implemented in their community. However, only a third of the respondents strongly agree with those statements.

We also looked at the correlation between the individual motivation of municipal actors to implement activation measures and structural measures, and the assessed status of the implementation of such measures within their municipality (see Table 3). The results show that there is a medium correlation between the individual motivation to implement activation measures (D1.1) and their assessed status of implementation within the municipality (D1.2). However, there is only a low and non-significant correlation between the individual motivation to implement structural measures (D2.1) and the assessed status of the implementation of such measures (D2.2). Moreover, there is a low correlation between the individual motivation to implement activation measures and the individual motivation to implement structural measures. The strongest correlation was found between the assessed status of the implementation of activation measures and the assessed status of the implementation of structural measures.

Table 3. Pearson's r between motivation and implementation.

	Individual Motivation to Implement Activating Measures (D1.1)	**Individual Motivation to Implement Structural Meas. (D2.1)**	**Assessed Status of Implementation of Activating Measures in Municipality (D1.2)**	**Assessed Status of Implementation of Structural Measures in Municipality (D2.2)**
D1.1	-			
D2.1	0.38 **	-		
D1.2	0.35 **	0.26 *	-	
D2.2	0.00	0.19	0.41 **	-

* significant at $p < 0.05$; ** significant at $p < 0.01$.

3.4. Correlation of Independent and Dependent Variables

3.4.1. Correlation and Simple Regression Analyses

Table 4 shows the Pearson's r correlation coefficients and the explained variance (R2) for the independent variables assumed to be relevant for the dependent variables. In the following, only the variables that showed to be statistically significant in both the correlation analyses and the simple regression analyses will be addressed. As can be seen in Figure 1, we did not assume any direct influence of the independent variables on the assessed status of implementation. Nonetheless, out of cognitive interest, the relation of the independent variables with the assessed status of implementation was analyzed.

Table 4. Pearson's r correlation coefficient (first value) and R2 (explained variance, second value) for the factors assumed to be relevant for the dependent variables.

	Individual Motivation to Implement Activating Measures (D1.1)	**Individual Motivation to Implement Structural Meas. (D2.1)**	**Ass. Status of Implementation of Activating Measures in Municipality (D1.2) *****	**Ass. Status of Implementation of Structural Measures in Municipality (D2.2) *****
ATTITUDES, BELIEFS, and KNOWLEDGE				
Risk appraisal				
R1. Risk experience appraisal	0.06/0.00	0.14/0.02	0.08/0.01	0.22 */0.05
R2. Future risk appraisal	0.19/0.04	0.01/0.00	0.26 */0.07 *	0.16/0.03
Efficacy appraisal				
E1. Perceived efficacy of department regarding implementation of protective measures (heavy rain)	0.26 */0.07 *	0.26 */0.07 *	0.17/0.03	0.06/0.00
E2. Perceived collective efficacy	0.27 */0.08 *	0.19/0.04	0.21 */0.04	−0.10/0.01
E3. Perceived efficacy of activating private households (general)	0.37 **/0.14 **	0.07/0.01	0.14/0.02	−0.06/0.00
E4. Perceived efficiency of structural measures	−0.20/0.04	0.12/0.01	−0.15/0.02	−0.06/0.00
Realizability appraisal				
F1. Perceived realizability of activating private households (+ activation)	0.62 **/0.38 **	0.29 **/0.08 *	0.47 **/0.22 **	−0.02/0.00
Responsibility appraisal				
Res1. Perceived governmental responsibility: mainly government	−0.16/0.03	0.18/0.03	−0.15/0.02	0.08/0.01
Res2. Perceived private responsibility: households also highly responsible	0.43 **/0.18 **	−0.04/0.00	−0.11/0.01	−0.21 */0.04
Knowledge appraisal				
K1. Perceived risk knowledge	0.49 **/0.24 **	0.25 */0.06	0.42 **/0.17 **	0.30 **/0.09 *
K2. Perceived adaptation knowledge	0.42 **/0.18 **	0.42 **/0.17 **	0.45 **/0.20 **	0.21 */0.04

*** As depicted in Figure 1, we assume hardly any (direct) influence of the independent variables on the assessed status of implementation. Nonetheless, the respective relation was analyzed and is reported out of cognitive interest; * significant at $p < 0.05$; ** significant at $p < 0.01$.

For variables relevant to risk appraisal (R1 and R2), there were no significant relations. Respondents with high-efficacy appraisal (E1–E3) were more likely to be motivated to carry out activation measures (D1.1), except for E4 (perceived efficacy of structural measures),

which showed no correlation with D1.1 nor with any of the other dependent variables. The general perception that their department could implement protective measures against the impacts of heavy rain events (E1) also significantly correlated with the motivation to implement structural measures (D2.1). The perceived realizability of activating private households (F1) showed the biggest effect on the motivation to conduct measures to activate private households, with smaller effects on the assessed status of the implementation of such measures (D1.2) and the motivation to carry out structural measures (D2.1). Of the variables relevant to responsibility appraisal, only the degree to which respondents agreed with the statement that private households are also highly responsible when it comes to preventing impacts from heavy rain events (Res2) showed a relation with the dependent variable D1.1: respondents who agreed with this statement were more likely to be motivated to implement activation measures. Both variables relevant to knowledge appraisal (K1 and K2) showed a significant correlation with all dependent variables (exception: no significant effect of K1 Perceived risk knowledge on D2.1 Motivation to implement structural measures).

3.4.2. Multiple Regression Analyses

For the multiple regression analyses, all variables that showed significant R2 values in the simple regressions were fed into the models for the four dependent variables (see Table 4 and Section 2.2 Steps of data analysis). In the following, details are only given for the variables that accounted for a statistically significant amount of variance. The coefficients of all independent variables are specified in Table S2 in the Supplementary Material.

For D1.1, the individual motivation to implement activating measures, the following variables were included into the model: E1, E2, E3, F1, Res2, K1, and K2. The regression model explained 49% of the variance of D1.1. The model was suitable for explaining the outcome ($F(7) = 9.27$, $p = 0.000$). F1 (perceived realizability of activating private households) and K1 (perceived risk knowledge) were the only independent variables accounting for a statistically significant amount of variance: F1 with $B = 0.483$, $t(67) = 3.968$, $p = 0.000$) and K1 with $B = 0.417$, $t(67) = 2.178$, $p = 0.033$.

For D2.1, motivation to implement structural measures, the following variables were included into the model: E1, F1, K2. The regression model explained 20% of the variance of D2.1. The model was suitable for explaining the outcome ($F(3) = 5.978$, $p = 0.001$). K2 (perceived adaptation knowledge) was the strongest independent variable with $B = 0.474$, $t(71) = 2.717$, $p = 0.008$ and the only one accounting for a statistically significant amount of the variance.

For D1.2, the assessed status of implementation of activating measures, the following variables were included into the model: F1, K1, K2. The regression model explained 31% of the variance of D1.2. The model was suitable for explaining the outcome ($F(3) = 9.389$, $p = 0.000$). F1 was the only independent variable accounting for a statistically significant amount of variance with $B = 0.345$, $t(63) = 2.717$, $p = 0.008$.

For D2.2, the assessed status of implementation of structural measures, K1 predicted 8% of the variance—a simple regression with K1 was performed, being the only variable that showed significant R2 from all independent variables. The model explained 8% of the variance with $F(1) = 6.875$, $p = 0.011$, with coefficients for K1: $B = 0.326$, $t(71) = 2.622$, $p = 0.011$.

To sum up, multiple regression analyses showed that after realizability (F1), perceived knowledge had the second largest influence on the motivation to implement adaptation measures, with perceived risk knowledge (K1) being relevant for activation measures (D1.1) and perceived adaptation knowledge (K2) being relevant for structural measures (D2.1).

4. Discussion

It could be shown that risk perception does not necessarily play a role in the motivation of municipal actors to implement adaptation measures. The influence of perceived

responsibilities of municipalities and private citizens and the influence of the perceived efficacy of adaptation measures seem to be relevant yet need to be better understood. However, it could be shown that the perceived realizability of adaptation measures and knowledge about risk and adaptation are key factors in the motivation to implement both activation and structural measures. This is in accordance with the observation by other researchers that municipalities often react hesitantly where climate adaptation is concerned, due to a lack of knowledge or rather certainty about (local) effects of climate change trends [40,49] or about judicial responsibilities [4,12]. Moreover, the results indicate that extensive knowledge about the risks of heavy rain events, possibly including knowledge of effects on private property, seems to help in understanding the urgency of implementing activation measures.

Surprisingly, neither responsibility appraisal (Res 1/Res 2) nor efficacy appraisal (E1–E4) showed any significant influence in the multiple regression analyses. However, the correlations offer a different picture: It can be seen that both the perception that citizens and governmental actors can implement effective measures through joint action (E2), and the perception that private households are also highly responsible to implement measures against heavy rain (Res2), correlate significantly with the motivation to implement activation measures (D1.1), while not showing any significant correlation with the motivation to implement structural measures (D2.1). Moreover, a vast majority of the respondents agree that joint action by private households and the municipalities is effective in preventing damage from heavy rain events (E2). Consequently, to put it simply, the concept of "collective efficacy" seems to come without cost but many benefits. This confirms observations by Born et al. [10] that the perceived collective efficacy, i.e., the belief that municipal actors and citizens can provide sufficient protection from the impacts of heavy rain through joint or collective action, might be key to successful adaptation to heavy rain, alongside the perceived responsibility of private households and the perceived responsibility of municipalities for structural measures. As stated above, this assumption could not be confirmed on the basis of the regression analyses. However, looking at the correlations, it can be assumed that there is presumably a connection between "collective efficacy" and the motivation to implement activation measures that we still need to understand better. Path analyses based on the assumptions underlying this research (see Figure 1) might be an interesting tool.

It was also shown that only a few respondents consider the activation of private households easy to realize. Reasons might be a general disregard for the issue of activating households due to a focus on structural measures, a lack of experience in activation measures, a (perceived) lack of (communication) skills necessary to implement activation measures, or a (perceived) lack of responsibility for activating private households. The exact causes are open to speculation and interesting questions for future research.

There are some limitations to this study that will be addressed in the following. The non-random sample of 77 respondents clearly limits the generalizability of the results. Moreover, the low response rate of 17.11% poses a potential source of bias [50,51], while at the same time being within one standard deviation of the average response rate to comparable online surveys [52]. We therefore consider the response rate as acceptable but as another reason to interpret the results tentatively by all means, further research being necessary to validate the results. Moreover, we do not know the duration of job affiliation, experience in (the implementation of) climate adaptation measures, or the position or the level of decision-making power of the respondents, which may have helped to interpret some of the results more precisely (e.g., for a municipal actor with a long job experience, a good network of municipal key actors, and a high level of decision-making power, it may be much easier to translate individual motivation into actual implementation by the municipal administration). Then again, the gap between individual motivation and implementation at the municipal level is most likely greatly influenced by factors beyond individual motivation, such as administrative structures, (the quality of) cross-sectoral cooperation and communication, and other factors identified as key (see introduction

of this paper; also see, e.g., [12]). Future interdisciplinary research, ideally combining psychological factors identified as relevant for individual motivation and political science analyses of administrative decision-making, is necessary to shed further light on these issues. Moreover, we need to keep in mind that, in many cases, the implementation of the structural measures is very resource-intensive in terms of time, money, and the necessary coordination between different administrative units. The implementation of activation measures often requires comparatively few of such resources, making it more likely that individual motivation can be translated into actual implementation of such measures (cf. measures listed in Table 2). Furthermore, merely analyzing the direct effect of the included independent variables on the motivation to implement activation or structural measures (and even their implementation!) is a stark simplification of the potential interplay of the independent variables. Further research is necessary to analyze how the variables influence each other, including analyses of moderator and mediator variables as well as interaction effects.

5. Conclusions

The results reported reveal a huge gap between the perceived importance of activating private households as part of dealing with heavy rain events (or rather the lack of agreement that structural measures are sufficient to protect private households) and the perceived realizability, i.e., the perception that it is actually possible to activate households. At the same time, the perceived realizability of activating measures showed the most prominent effect on the motivation to implement activation measures and also correlated with their actual implementation. If the goal of the DAS to activate private households is to be taken seriously, these results should be a wake-up call: Rather than just making assumptions about the potential of activation measures to motivate people to take self-protective measures, such measures should be evaluated [4,21]. Such evaluations could contribute to a better understanding of which activation measures actually foster the motivation for, and implementation of, self-protective measures. This is highly relevant to the decision of which activation measures to finance and implement [4,21]. Accordingly, light needs to be shed on the assumptions based on which municipal actors assess the effectiveness of activation measures. Moreover, such evaluations, ideally combined with cost-benefit analyses, may make it easier for municipal actors, who are motivated to implement activation measures, to press through their cause. However, since perceived realizability had a bigger impact than perceived effectiveness on the motivation to implement activation measures, it may be important not only to communicate that activation measures can be effective, but also to show good practical examples, thereby communicating that it is indeed possible to implement such measures. Additionally, from a very practical point of view, it may be helpful to promote and provide supporting structures facilitating the implementation of activation measures (e.g., list of sponsorship programs, submission templates for public money, list of facilitators) to increase the (perceived) realizability of the implementation of activation measures and to promote examples of good practice through transdisciplinary projects, for instance.

It should also be kept in mind that the individual motivation of municipal actors is far from equaling implementation at the municipal level. This is illustrated by the lack of correlation between the individual motivation to implement structural measures and the implementation of such measures, which underlines the importance of future research on the barriers that impede implementation despite individual motivation, ideally elaborating on starting points to overcome such barriers. However, there was a reasonable correlation between the implementation of activation measures and the implementation of structural measures. Interestingly enough, though, risk appraisal (assessment of past and future impacts of heavy rain) was found to have hardly any influence. This implies that there may be something such as a general supportive disposition towards the implementation of heavy-rain-related measures—be it structural or activation measures—independent of the perceived risk. Or, looking at the other side of the coin, there seem to be certain barriers

impeding the implementation of structural measures despite the opposite motivation of municipal actors. This confirms findings of other researchers showing that several, often not climate-specific, obstacles can prevent or delay the implementation of local adaptation measures, such as financial restrictions and lack of support from the public, the local economy, politics, or the local government [3], decisions focusing on short periods of time (often election periods) [50], and opinions of certain influential local authorities [8,11,49]. Barriers that are specifically relevant to activation measures seem to be sectoral thinking and acting, uncertainty about competences/responsibilities for activation measures, and activation measures not being defined as statutory duties or cost (cf. [12]). Moreover, there is a lack of staff in municipalities assigned to the task of climate adaptation [11]. Climate-related barriers can be the long-term scale of climate change and its uncertainties, especially with regard to the local level [14].

We would like to conclude by putting the research presented in perspective: We were able to offer some insights into factors central to the motivation of municipal actors to implement activation and structural measures while at the same time recognizing that "administrative circumstances" (see key factors described above) are the factors that largely make possible or impede the implementation of adaptation measures. However, motivation can be crucial, especially in complex situations where uncertainty about regulative issues, financial constraints, and a lack of statutory duties and other challenges on top of climate-related uncertainties may make it seem the easy way out to try for no more adaptation than absolutely necessary, especially when taking into account that sometimes it is one specific person that presses ahead the subject of climate adaptation.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su13137019/s1, Table S1. 'Heavy rain in your city–your opinion counts!'; questionnaire items and responses in %; Table S2. Coefficients for the explanatory variables from multiple regression analyses for the four dependent variables.

Author Contributions: Conceptualization, J.L.W., T.G., and S.L.; methodology, J.L.W., S.L., and T.G.; analysis of survey data, J.L.W.; writing—original draft preparation, J.L.W.; writing—review and editing, J.L.W., T.G., and S.L.; visualization, J.L.W.; project administration, S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research work received no external funding. The research team supporting the conceptualization of the project was jointly involved in the project rain//secure (Regen//Sicher), which was funded by the German Environment Agency under the support code 3716 48 103 0.

Institutional Review Board Statement: Ethical approval was not necessary in the context of the study due to research regulations in Germany. Consent was obtained through the respondents participating in the survey and ticking off the statement that they read and understood the information on data protection and agree with the conditions of participation. Information on anonymity was given on the first page of the survey, and a contact person for questions regarding data protection or the survey in general was provided.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: We acknowledge support by the German Research Foundation (DFG) and the Open Access Publication Fund of Humboldt-Universität zu Berlin.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. GDV. *Naturgefahrenreport 2019*; GDV: Berlin, Germany, 2019.
2. Deutscher Wetterdienst (DWD). Wetterlexikon: Starkregen. Available online: https://www.dwd.de/DE/service/lexikon/begriffe/S/Starkregen.html (accessed on 22 February 2021).
3. Hasse, J.; Willen, L. *Umfrage Wirkung der Deutschen Anpassungsstrategie (DAS) für Die Kommunen. Teilbericht*; Deutsches Institut für Urbanistik: Dessau-Roßlau, Germany, 2019.

4. Kind, C.; Kaiser, T.; Riese, M.; Bubeck, P.; Müggenburg, E.; Thieken, A.; Schüller, L.; Fleischmann, R. *Vorsorge Gegen Starkregenereignisse und Maßnahmen zur Wassersensiblen Stadtentwicklung—Analyse des Standes der Starkregenvorsorge in Deutschland und Ableitung Zukünftigen Handlungsbedarfs*; Umweltbundesamt: Dessau, Germany, 2019.
5. IPCC. *Climate Change 2013: The Physical Science Basis*; Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2013; pp. 15–35. [CrossRef]
6. Bund-/Länderarbeitsgemeinschaft Wasser (LAWA). *LAWA—Strategie für ein Effektives Starkregenrisikomanagement*; LAWA: Erfurt, Germany, 2018.
7. Revi, A.; Satterthwaite, D.; Aragón-Durand, F.; Corfee-Morlot, J.; Kiunsi, R.; Pelling, M.; Roberts, D.; Solecki, W. *Urban Areas Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*; Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Field, C.B., Barros, V.R., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Abdrabo, M.A.-K., Adger, W.N., Anokhin, Y.A., Anisimov, O.A., Aren, D.J., et al., Eds.; Cambridge University Press: Cambridge, UK, 2014; pp. 535–612.
8. Hackenbruch, J.; Kunz-Plapp, T.; Müller, S.; Schipper, J.W. Tailoring Climate Parameters to Information Needs for Local Adaptation to Climate Change. *Climate* **2017**, *5*, 25. [CrossRef]
9. Haupt, W. Interkommunales Lernen—Definition, Bedeutung und Potenzial für die lokale Klimawandelanpassung. In *Kooperation und Innovation für eine Nachhaltige Stadtentwicklung: Forschung mit Innovativen Kommunen*; Neumann, T., Ziesler, U., Teich, T., Eds.; Springer Fachmedien: Wiesbaden, Germany, 2020; pp. 189–203. ISBN 978-3-658-29554-7.
10. Born, M.; Körner, C.; Löchtefeld, S.; Werg, J.; Grothmann, T. *Erprobung und Evaluierung von Kommunikationsformaten zur Stärkung Privater Eigenvorsorge*; Das Projekt Regen//Sicher. Climate Change 07/2021; Umweltbundesamt: Dessau, Germany, 2021.
11. Die Bundesregierung. *Fortschrittsbericht zur Deutschen Anpassungsstrategie an den Klimawandel*; Die Bundesregierung: Berlin, Germany, 2015.
12. Schüle, R.; Fekkak, M.; Lucas, R.; von Winterfeld, U. *Kommunen Befähigen, die Herausforderungen der Anpassung an den Klimawandel Systematisch Anzugehen (KoBe)*; Climate Change 20/2016; Umweltbundesamt: Dessau, Germany, 2016.
13. Dewulf, A.; Meijerink, S.; Runhaar, H. The Governance of Adaptation to Climate Change as a Multi-Level, Multi-Sector and Multi-Actor Challenge: A European Comparative Perspective. *J. Water Clim. Chang.* **2015**, *6*, 1–8. [CrossRef]
14. Biesbroek, G.R.; Klostermann, J.E.; Termeer, C.J.; Kabat, P. On the Nature of Barriers to Climate Change Adaptation. *Reg. Environ. Chang.* **2013**, *13*, 1119–1129. [CrossRef]
15. 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]
16. Conring, G.; Hübner, C. *Bürgerbeteiligung in der Hochwasserbewältigung*; Dpart—Forschung für Politische Partizipation: Berlin, Germany, 2015.
17. Kuhlicke, C.; Seebauer, S.; Hudson, P.; Begg, C.; Bubeck, P.; Dittmer, C.; Grothmann, T.; Heidenreich, A.; Kreibich, H.; Lorenz, D.F. The Behavioral Turn in Flood Risk Management, Its Assumptions and Potential Implications. *Wiley Interdiscip. Rev. Water* **2020**, *7*, e1418. [CrossRef]
18. Mees, H.; Crabbé, A.; Alexander, M.; Kaufmann, M.; Bruzzone, S.; Lévy, L.; Lewandowski, J. Coproducing Flood Risk Management through Citizen Involvement: Insights from Cross-Country Comparison in Europe. *Ecol. Soc.* **2016**, *21*. [CrossRef]
19. Bubeck, P.; Kreibich, H.; Penning-Rowsell, E.C.; Botzen, W.; de Moel, H.; Klijn, F. Explaining Differences in Flood Management Approaches in Europe and in the USA–A Comparative Analysis. *J. Flood Risk Manag.* **2017**, *10*, 436–445. [CrossRef]
20. Thieken, A.H.; Kienzler, S.; Kreibich, H.; Kuhlicke, C.; Kunz, M.; Mühr, B.; Müller, M.; Otto, A.; Petrow, T.; Pisi, S. Review of the Flood Risk Management System in Germany after the Major Flood in 2013. *Ecol. Soc.* **2016**, *21*. [CrossRef]
21. Grothmann, T. *Was Motiviert Zur Eigenvorsorge? Motivationseffekte von Beteiligungsprozessen in Der Klimawandelanpassung*; Climate Change 20/2017; Umweltbundesamt: Dessau, Germany, 2017.
22. Grothmann, T.; Michel, T. Participation for building urban climate resilience? Results from four cities in Germany. In *Building Resilience to Natural Hazards in the Context of Climate Change—Knowledge Integration, Implementation, and Learning*; Hutter, G., Neubert, M., Ortlepp, R., Eds.; Springer: Berlin/Heidelberg, Germany, 2010.
23. Beese, K.; Fekkak, M.; Katz, C.; Körner, C.; Molitor, H. *Anpassung an Regionale Klimafolgen Kommunizieren: Konzepte, Herausforderungen Und Perspektiven*; Oekom Verlag: Munich, Germany, 2014; ISBN 3-86581-597-9.
24. BMVBS (Hrsg.). *Kommunikationsinstrumente im Anpassungsprozess an den Klimawandel. Erfahrungen aus Beteiligungsprozessen in den StadtKlima—ExWoSt-Modellprojekten*; Nr. 28/2013; Bundesministerium für Verkehr, Bau und Stadtentwicklung: Berlin, Germany, 2013.
25. Brunnengräber, A.; Dietz, K. Transformativ, Politisch und Normativ: Für eine Re-Politisierung der Anpassungsforschung. *Gaia* **2013**, *22*, 224. [CrossRef]
26. Knierim, A.; Baasch, S.; Gottschick, M. *Partizipation und Klimawandel: Ansprüche, Konzepte und Umsetzung*; Oekom Verlag: Munich, Germany, 2013; ISBN 3-86581-577-4.
27. Rotter, M.; Hoffmann, E.; Hirschfeld, J.; Schroeder, A.; Mohaupt, F.; Schaefer, L. *Stakeholder Participation in Adaption to Climate Change-Lessons and Experience from Germany*; Bundesministerium für Verkehr, Bau und Stadtentwicklung: Berlin, Germany, 2012.

28. Hagelstange, J.; Rösler, C.; Runge, K. *Klimaschutz, Erneuerbare Energien und Klimaanpassung in Kommunen. Maßnahmen, Erfolge, Hemmnisse und Entwicklungen—Ergebnisse Der Umfrage 2020*; Deutsches Institut für Urbanistik: Dessau-Roßlau, Germany, 2021.
29. Werg, J.L.; Grothmann, T.; Spies, M.; Mieg, H.A. Factors for Self-Protective Behavior against Extreme Weather Events in the Philippines. *Sustainability* **2020**, *12*, 6010. [CrossRef]
30. van Valkengoed, A.M.; Steg, L. Meta-Analyses of Factors Motivating Climate Change Adaptation Behaviour. *Nat. Clim. Chang.* **2019**, *9*, 158–163. [CrossRef]
31. Zheng, Y.; Dallimer, M. What Motivates Rural Households to Adapt to Climate Change? *Clim. Dev.* **2016**, *8*, 110–121. [CrossRef]
32. Grothmann, T.; Reusswig, F. People at Risk of Flooding: Why Some Residents Take Precautionary Action While Others Do Not. *Nat. Hazards* **2006**, *38*, 101–120. [CrossRef]
33. Siedschlag, D. *Hochwasser & Eigenvorsorge—Untersuchung von Einflussfaktoren Persönlicher Schutzmaßnahmen*; UFZ-Bericht: Leipzig, Germany, 2010.
34. Lo, A.Y. The Role of Social Norms in Climate Adaptation: Mediating Risk Perception and Flood Insurance Purchase. *Glob. Environ. Chang.* **2013**, *23*, 1249–1257. [CrossRef]
35. Grothmann, T. *Wetterextreme und Private Schadensprävention—Enwicklung, Überprüfung und Praktische Anwendbarkeit der Theorie Privater Proaktiver Wetterextrem-Vorsorge*; Otto-von-Guericke-Universität: Magdeburg, Germany, 2005.
36. Adeola, F. Katrina Cataclysm: Does Duration of Residency and Prior Experience Affect Impacts, Evacuation, and Adaptation Behavior Among Survivors? *Environ. Behav.* **2009**, *41*, 459–489. [CrossRef]
37. Peacock, W.G. Hurricane Mitigation Status and Factors Influencing Mitigation Status among Florida's Single-Family Homeowners. *Nat. Hazards Rev.* **2003**, *4*, 149–158. [CrossRef]
38. Bamberg, S.; Masson, T.; Brewitt, K.; Nemetschek, N. Threat, Coping and Flood Prevention—A Meta-Analysis. *J. Environ. Psychol.* **2017**, *54*, 116–126. [CrossRef]
39. Werg, J.; Grothmann, T.; Schmidt, P. Assessing Social Capacity and Vulnerability of Private Households to Natural Hazards-Integrating Psychological and Governance Factors. *Nat. Hazards Earth Syst. Sci.* **2013**, *13*, 1613–1628. [CrossRef]
40. Storbjörk, S. Governing Climate Adaptation in the Local Arena: Challenges of Risk Management and Planning in Sweden. *Local Environ.* **2007**, *12*, 457–469. [CrossRef]
41. Roggero, M.; Thiel, A. *Institutionen, Akteure und Normative Aspekte der Klimaanpassung*; Institut für Ökologische Wirtschaftsforschung GmbH: Berlin, Germany, 2014.
42. Barion, D.; Schrenk, G. *Projektbericht zum Vorhaben Audit Hochwasser—Wie Gut Sind Wir Vorbereitet Überprüfung von Kommunen, Trägern Kommunaler Belange Sowie Industrie- und Gewerbebetriebe in Hinsicht auf die Frage der Hochwasservorsorge*; DWA: Hennef, Germany, 2013.
43. Bubeck, P.; Botzen, W.J.; Kreibich, H.; Aerts, J.C. Detailed Insights into the Influence of Flood-Coping Appraisals on Mitigation Behaviour. *Glob. Environ. Chang.* **2013**, *23*, 1327–1338. [CrossRef]
44. Ahlhelm, I.; Frerichs, S.; Hinzen, A.; Noky, B.; Simon, A.; Riegel, C.; Trum, A.; Altenburg, A.; Janssen, G.; Rubel, C. *Klimaanpassung in der Raeumlichen Planung: Starkregen, Hochwasser, Massenbewegungen, Hitze, Duerre-Gestaltungsmoeglichkeiten Der Raumordnung und Bauleitplanung*; FGSV Verlag GmbH: Berlin, Germany, 2016.
45. Koch, M.; Behnken, K.; Schneider, B.; Gatke, D.; Thielking, K.; Wurthmann, J.; Hoppe, H.; Kirschner, N.; Benden, J.; Gerdes, D. *KLimaAnpassungsStrategie Extreme Regenereignisse (KLAS). Schlussbericht des Projektes "Umgang mit Starkregenereignissen in der Stadtgemeinde Bremen"*; KLAS: Bremen, Germany, 2015.
46. Kazmierczak, A.; Bittner, S.; Breil, M.; Coninx, I.; Johnson, K.; Kleinenkuhnen, L.; Kochova, T.; Lauwaet, D.; Nielsen, H.O.; Smith, H. *Urban Adaptation in Europe: How Cities and Towns Respond to Climate Change*; Wageningen University & Research: Wageningen, The Netherlands, 2020.
47. Döring, N.; Bortz, J. *Forschungsmethoden und Evaluation*; Springerverlag: Wiesbaden, Germany, 2016.
48. Bryman, A.; Cramer, D. *Quantitative Data Analysis for Social Scientists*; Routledge: London, UK, 1994.
49. Martinez, G.; Bray, D. *Befragung Politischer Entscheidungsträger zur Wahrnehmung des Klimawandels und zur Anpassung an den Klimawandel an der Deutschen Ostseeküste*; RADOST-Berichtsreihe: Berlin, Germany, 2011.
50. Lehmann, P.; Brenck, M.; Gebhardt, O.; Schaller, S.; Süßbauer, E. Barriers and Opportunities for Urban Adaptation Planning: Analytical Framework and Evidence from Cities in Latin America and Germany. *Mitig. Adapt. Strateg. Glob. Chang.* **2015**, *20*, 75–97. [CrossRef]
51. Kelley, K.; Clark, B.; Brown, V.; Sitzia, J. Good practice in the conduct and reporting of survey research. *Int. J. Qual. Health Care* **2003**, *15*, 261–266. [CrossRef] [PubMed]
52. Baruch, Y.; Holtom, B.C. Survey response rate levels and trends in organizational research. *Hum. Relat.* **2008**, *61*, 1139–1160. [CrossRef]