



Turning regret into future disaster preparedness with no regrets

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Abstract. Global efforts are focusing on long-term preparedness for disasters, highlighting the need to make well-informed decisions in advance to avoid panic behaviour when a disaster strikes. Making well-informed decisions includes the evaluation of the potential outcomes of a decision or action to avoid regretting them afterwards. However, little is known about what we regret about our actions and inactions in the context of disasters. Using the responses of a survey disseminated in flood-affected areas in Germany in 2021, this study dives into the post-disaster regrets of citizens (438 respondents). The results showed that participants only regretted preparedness actions when the actions threatened their life, but mostly, participants regretted their inaction. Overall, the results indicate the need to promote long-term preparedness, which can be supported by the “no-regrets” approach. Furthermore, the need to integrate actions supporting psychological preparedness was identified.

1 Introduction

Ich wurde von dem steigenden Wasser geweckt, als ich mit meiner Schlafcouch durchs Zimmer schwamm [I was woken up by the rising water as I swam across the room on my couch].

After experiencing a flood, we reflect on the past events and moments, such as when awoke on the couch because it was floating through the room. In this moment, we start thinking, “What if I had received a warning and prepared for the flood?” The reflections on the past and thinking about the “what if” can make us regret decisions and actions that had negative outcomes or regret actions we failed to take (Feld-

man and Chen, 2019; Feldman et al., 1999; Gilovich and Medvec, 1994; Zeelenberg et al., 2002). Regret is an emotion of blaming ourselves, but regret and the experience itself also support us in adapting for future flooding (Hung, 2020; Kuang and Liao, 2020; Zeelenberg and Pieters, 2007).

The floods in Germany in July 2021 have left many regrets but also many starting points for enhancing future disaster preparedness. Although the event was forecasted well in advance at both the European and national level (Thieken et al., 2023), the floods took hundreds of citizens by surprise because they did not receive any warning or did not take the warnings seriously (Fekete and Sandholz, 2021). The citizens who did not expect flooding did not have had time to prepare and, therefore, were overwhelmed by the water entering their homes (Lemnitzer et al., 2021; Thieken et al., 2023). Some citizens who received warnings could not imagine the approaching flood and, hence, did not prepare (Ommer et al., 2024b). In addition, it is widely acknowledged in risk perception studies that preparedness actions are dependent on peoples’ (perceived) ability to act (Kuhlicke et al., 2020a; Bubeck et al., 2012). Here, ability refers to not only our physical ability but also psychological or even financial ability. The lack of preparedness, together with people taking risky actions such as driving through flood water or going downstairs into flooded basements, caused a high number of lost lives (Thieken et al., 2022).

The floods further reminded us that many citizens have a reactive or flood-defensive mindset rather than a proactive one (Ommer et al., 2024a). Moreover, this study further reflected on disaster and risk governance structures in Germany as they are perceived by citizens: by law, citizens are responsible for preparing their own property for hazards such as flooding, but the survey responses highlighted the fact that

citizens show high dependence on government authorities, as they project most governance responsibilities onto them.

Rare events like this disaster in 2021 are deeply uncertain and, therefore, need to be adapted to in advance rather than taking action only after receiving a warning (which sometimes may not arrive) (Marchau et al., 2019). A proactive mindset can enhance our ability to act fast when we receive a warning, which otherwise perhaps results in irrational, reflexive, or panic decision-making (Geaves et al., 2023; Xenidis and Kaltsidi, 2022). Hence, to make good decisions regarding preparedness actions, we need time to evaluate the potential impact of our actions to ensure that we will not regret them in the future (Robinson and Botzen, 2018; Sunderajan and Albarracín, 2021; UNDRR, 2022).

This raises the following research questions: which (in)actions do we actually regret, and why do we regret them. Commonly communicated preparedness actions include preparing the home for the intrusion of water by moving valuable things upstairs, installing pumps in a basement, or preparing an emergency kit (Kreibich et al., 2011; Martins et al., 2019). These actions can be performed in a relatively short time, for instance, after receiving a warning. Although these actions are very valuable for protecting our home and properties, they were recently claimed to be “weak preparations” where we are “blindly following” instructions (Katsikopoulos, 2021). In fact, (proactive) disaster preparedness targets the strengthening of knowledge and capabilities “to effectively anticipate, respond to, and recover from the impacts” (Sendai Framework Terminology on Disaster Risk Reduction, 2023), which may not always be achieved with weak preparedness actions. Hence, stronger and long-term preparedness actions instead include developing a (household) emergency plan and practising it (Katsikopoulos, 2021).

Considering that the uncertainty about whether we will be affected by a hazard or not is one major barrier to long-term preparedness (especially if we have no prior hazard experience), an interdisciplinary strategy for decision-making under uncertain conditions could be applied: the “no-regrets” approach (Marchau et al., 2019). First integrated into climate policies in the 1990s, the no-regrets approach fosters taking actions that are robust in different future scenarios (i.e. no-, low-, or high-impact hazards). According to Heltberg et al. (2009), actions shall, firstly, not be regretted in any future scenario and, secondly, not be costly and entail benefits. These values motivate people to take the actions since our decisions are driven by the aim of avoiding regret but are also driven by economics and benefits that represent a reward (Sunderajan and Albarracín, 2021).

The no-regrets decision-making strategy was later adopted in disaster risk reduction research (Plume, 1995; Heltberg et al., 2009; Debele et al., 2023). Despite the widespread application of the no-regrets approach, its potential to guide individual preparedness actions remains largely unexplored. In fact, current research neglects the applicability of the approach to individual decision-making and preparedness,

where actions generally need to be easy to implement, low cost, and (psychologically) robust. Moreover, disaster preparedness research often emphasises proactive measures and risk perception but rarely considers the post-disaster emotional and cognitive reflections (e.g. regret) and their role in shaping future preparedness. Integrating the no-regrets approach with insights from post-disaster reflections can support the development of practical strategies for individual preparedness.

To fill these two gaps, this study explores the flooding event in Germany in 2021 from a regret perspective. Using an online survey disseminated in flood-affected areas, this study dives into citizens’ preparedness actions before the event and for the future. The main objective is to gain insights into the actions that participants regretted or did not and why. Acknowledging that regret is a cognitive process and is, therefore, highly subjective, this study aims to derive a broad overview of potential regrets of citizens. Secondly, the outcomes of the survey will be used to form recommendations for long-term disaster preparedness and for the suitability of the no-regrets approach as a framework for individual disaster preparedness.

To learn more about the flooding event, Sect. 1.1 provides a summary about the flooding event and its impacts. Section 2 presents the survey design and data analysis. The results, providing insights into the regrets (and lack thereof) of citizens are introduced in Sect. 3, discussed in Sect. 4, and concluded in Sect. 5.

The floods in Germany in 2021

The low-pressure system Storm Bernd brought heavy precipitation to western Europe between 12 and 15 July 2021, which cascaded into flooding and caused devastating impacts (Kreienkamp et al., 2021; Lemnitzer et al., 2021).

Germany (and its neighbouring countries) experienced severe rainfall after a 3-week period of wet days (Dietze et al., 2022). While heavy rainfall hit many parts of the country, the federal states of Rhineland-Palatinate and North Rhine-Westphalia experienced particularly high amounts of precipitation, causing local flooding. The two states are located in the western region of Germany bordering the Netherlands, Luxembourg, Belgium, and France. In these states, many small- and medium-sized rivers exceeded their banks during the flooding event (Lehmkuhl et al., 2022).

Heavy precipitation of up to 180 mm within 72 h led to various types of flooding (Dietze et al., 2022; Junghänel et al., 2021; Lehmkuhl et al., 2022). The initial high saturation level of soils led quickly to surface runoff and pluvial flooding (Dietze et al., 2022), while the runoff on hillslopes transformed into small streams, forming gullies (Lemnitzer et al., 2021). Flash floods occurred in the middle hill catchments where steep slopes are a common landscape feature (Thieken et al., 2023). Additionally, water reservoirs filled up quickly and proved a danger to their dams and the downstream pop-

ulation (Lehmkuhl et al., 2022). Lastly, urban fluvial flooding occurred in cities along rivers and streams (Thieken et al., 2023).

In Germany, about 162 km² was inundated, primarily affecting the agricultural sector, with 88 km² of flooded agricultural land (He et al., 2022). The event was referred to as a 400-year event, but it highlighted the fact that these kinds of events can occur more often (Kreienkamp et al., 2021). The results of this study further suggested the influence of climate change on the intensity of this rainfall event and on future events.

Overall, the floods led to devastating damage costing EUR 32 billion (Mohr et al., 2023). The damage to roads, bridges, and other critical infrastructure further complicated evacuation and emergency response (Fekete and Sandholz, 2021; Koks et al., 2022). Most importantly, more than 180 people lost their lives, and hundreds of people were injured or displaced (Dietze et al., 2022; Thieken et al., 2023). According to an evaluation in the federal state of North Rhine-Westphalia (Thieken et al., 2022), most people lost their lives in their cars, on the street, in a basement, or on the ground floor. Most of these people drowned in the flood waters, a few lost their life due to heart failure, and two because of burn injuries from oil-fired heating.

2 Methods

2.1 Online survey

To gain a better understanding of the perspective of affected citizens on this event and regarding their own (in)action, an online survey was designed to gather a spatially wide collection of responses. To give these citizens a voice, the survey (in the Supplement) encompassed primarily open questions regarding the flood source, risk estimation, preparedness, response, early warning, issues that were perceived and suggested solutions for these, and basic demographic questions (age, living situation, and postcode). The survey was designed in two languages (German and English). After approval by the ethics committee of the University of Reading (February 2022), the survey was open from March to July 2022 and invited flood-affected citizens (18 years and older) from the two states of Rhineland Palatinate and North Rhine-Westphalia to share their experiences. It was disseminated using Microsoft Forms via social media channels such as Facebook, Twitter, LinkedIn, and WhatsApp. The nature of the design of the study and the dissemination strategy may have lead to biases (i.e. Ong et al., 2023) in age groups, risk awareness, or the personality of participants, as it may have promoted the participation of generally more active and engaged people.

2.2 Data analysis

The responses were stored in Microsoft Excel and were pre-processed, which included the translation of responses into English, the correction of postcodes, and the adding of municipality and district names (based on the postcodes).

Descriptive statistics were used to analyse basic questions regarding the age structure and living situation, location, and flood experience. In total, 438 responses were collected. The majority of participants (87.7 %) were living in North Rhine-Westphalia at the time of the flooding, with 12.3 % in Rhineland Palatinate. 65 % of the participants were aged between 25 and 54 years, but respondents also covered the age groups of 18–24 years (6 %), 55–64 years (19 %), and 65 years and older (9 %). The age structure of the survey participants is comparable to the German national age structure in 2022 (Statistisches Bundesamt, 2024) but shows a slight overrepresentation of the age group 25 to 54 years. Almost two-thirds of the participants owned a house in July 2021, and about one-fifth were living in a rental apartment. Other participants were living in a rented house (7 %), owned a flat (4 %), or were living with their parents or guardians (3 %).

Open questions were analysed qualitatively utilising thematic analysis (Braun and Clarke, 2006). This allowed a deeper insight into the survey results by identifying overarching themes. Applied to the thematic analysis, all questions were analysed to distil themes that appeared across these questions. The workflow included familiarisation with the responses followed by an initial coding in Nvivo (release 1.7.1), which highlighted the themes of inaction and regret. Using Microsoft Excel, these themes were explored in more depth by manually coding the responses into categories, i.e. reasons for inaction. The results of the thematic analysis are presented and discussed in Sect. 3 and concluded in Sect. 4.

The main questions used for the thematic analysis were (question 5 (Q5)) the actions after a warning message was received, (Q6) the actions when the water arrived, and (Q15) what people would do differently if they received a warning today. All responses were filtered by participants expressing (no) regret in their replies. This process showed that most people who expressed regret did experience flooding directly (as selected in Q2). More details on how and why people expressed regrets is presented in the following section.

3 Results

Reflection on previous behaviours, actions, and their outcomes and raising the question of “what if” is a typical process that often leads to the feeling of regret (Feldman et al., 1999; Zeelenberg et al., 2002). In the survey, some participants implied regrets about their preparedness behaviour, especially about the actions they did not take – their inaction (Sect. 3.1) – and actions that posed a risk to their lives (Sect. 3.2). However, a few participants explicitly men-

tioned that they did not regret anything about their own behaviour (Sect. 3.3). Regret was further expressed in their replies about what they would do differently if another flood approached in the future (Sect. 3.4). This showed that the participants have been evaluating their actions and inaction and considering what they could have done (differently).

3.1 Inaction causing the feeling of regret

The majority of regrets expressed by participants were related to inaction. Inaction regrets were found related to flood mitigation and preparedness measures, evacuation, seeking information, and helping others. Missing the chance to take actions because of different reasons is a common cause for regret (Gilovich and Medvec, 1994). 29.6 %¹ of the participants wrote that they did nothing (*nichts, nix*) to prepare. This preparedness inaction was linked to the lack of time to take action because of the unexpectedness of the event. More reasons for not preparing were the fact that, for example, people did not understand the warning properly or they could simply not imagine an event like this ($N = 31$), they were not at home ($N = 9$), they were in shock ($N = 3$), they could not act because they felt powerless ($N = 3$), or other reasons ($N = 10$).

Overall, most regrets were related to time, as participants would have liked to prepare earlier (*früher*), in time (*rechtzeitig*), or immediately (*sofort, direkt handeln, zeitig*).

In der kurzen Zeit, keine Stunde vor dem Ereigniss, konnte man nichts mehr machen [In the short time, less than an hour before the event, there was nothing more one could do].

This lack of time and negative experiences from the flooding were associated with the trust in the early warning. In this context, participants highlighted the fact that they regret trusting the dissemination of early warnings and the support by the local authorities, which they see as the cause for the stressful and dangerous situation that they found themselves in.

Keine warnung – Flucht – Keinem vertrauen – Alles (anders machen) [No warning – escape – trust no one – do everything (differently)].

Ich verlasse mich nicht mehr auf Warnung[en]! Falls welche kommen!!! Selber die Umgebung/-Naturi m Auge behalten [I no longer rely on warnings! In any case, whatever comes!!! Keep an eye on the surroundings/nature myself].

Contrarily, some participants received warnings but did not take them seriously and, hence, did not take any preparedness actions. Regardless of the reason for participants'

¹ Note that this and the following numbers were derived from a non-mandatory question (Q5): how did you react and what did you do when you learnt about potential flooding?

inaction, the inaction was commonly regretted. Also, in the following case, the participant did not act upon the warnings received a few days earlier but then responded to the water entering the basement.

Ich habe der Warnung leider nicht genug Beachtung geschenkt, also nichts [vorbereitet] [Unfortunately, I did not pay enough attention to the warning, so [I prepared] nothing].

One reason for not taking the warning seriously was that there had been too many warnings, especially considering the recent Covid-19 pandemic for which the same warn app was utilised. This effect is commonly referred to as alert fatigue (Potter et al., 2018; Roberts et al., 2022). Another participant who did not take the warning seriously mentioned that when the flood arrived, they tried to react but gave up at some point.

3.2 Actions causing the feeling of regret

Flooding was largely unexpected by the survey participants primarily because of the untimely or late warning or no warning at all. Roughly half of the participants did not receive any warning considerably in advance of the event (24 h or more). Asking the participants when they received the first warning, about 20 % did not receive any warning before the water arrived, 26 % noted that they received a warning only a few hours before, and about 14 % were “warned” by the arriving or intruding water itself. Not receiving a warning in time left several participants in difficult situations, as these surprise moments left participants no or minimal time; thus, decisions were made in panic or reflexively, leading to irrational action taking (Geaves et al., 2023; Xenidis and Kaltsidi, 2022).

Ich habe versucht Dinge zu retten und habe wichtige Dinge vergessen. Man handelt irrational [I tried to save things and forgot important things. One acts irrationally].

One participant started acting when the water was already filling up the basement because no warnings were received in advance. The person believed that a small amount of flooding might occur and reflected on the wishful thinking that the rain would stop soon. However, when the water entered the house, the participant described the following actions as just functioning without thinking:

Ich habe den Keller ausgeräumt. Was im Nachhinein sehr gefährlich war. Das würde ich nicht mehr machen [I cleaned out the basement. Which, in retrospect, was very dangerous. I wouldn't do that anymore].

Regret was expressed by this participant when the action turned into a threat to their life. This can be explained by regret theory: when an action had or might have had a negative outcome, we start thinking about the “what if” –

imagining what we could have done differently to achieve a more positive outcome (Zeelenberg et al., 2002). In the above quote, the participant recognised afterwards that going downstairs into a flooded basement can be very dangerous. Indeed, drowning in the basement was one of the major threats to lives during this flooding event (Thieken et al., 2022).

Similarly, driving or walking in flood water was assessed as a major cause of death during this event in 2021. In this regard, one participant (who expected the usual flooding but was surprised by extreme flooding) reflected that driving should have been avoided to stay safe.

Zuhause bleiben und nicht mehr versuchen mit dem Auto zu fahren [Stay at home and stop trying to drive the car].

3.3 No-regrets actions

Overall, participants mentioned that they undertook a variety of short-term emergency measures (Kreibich et al., 2011; Martins et al., 2019) such as preparing the house and basement for potential water intrusion; moving valuable furniture, documents, photos, and more upstairs; preparing emergency escape bags; storing food; and filling water canisters. Interestingly, none of the participants mentioned that they regretted having taken any of these actions.

In addition, a few participants directly expressed that they did not regret anything about their actions. For instance, one participant living in a rental apartment mentioned that they were worried but managed to stay calm.

Wir waren schon etwas besorgt, aber haben Ruhe bewahrt. Hätten wir vorher gewusst, dass es viel schlimmer wird als vorhergesagt, hätten wir unser Heim verlassen [We were somewhat worried but kept calm. Had we known beforehand that it would be much worse than predicted, we would have left our home].

Similarly, another participant who experienced extreme flooding on their property highlighted the fact that acting very prudently was not to be regretted.

Tatsächlich nichts, ich bin sehr besonnen vorgegangen, allerdings wäre eine vorherige Information seitens der Gemeinde helfend gewesen [Actually nothing, I proceeded very prudently; however, prior information from the municipality would have been helpful].

Moreover, no regrets were expressed by participants who stated that they had done everything they could do within their (perceived) abilities to act and self-organise (self-efficacy; Kievik and Gutteling, 2011).

Versucht es aufzuhalten, das Wichtigste gerettet, dann selbst gerettet [Tried to stop it, saved the most important things, then saved myself].

Sachen gepackt, Familie, Nachbarn und Freunde in Sicherheit gebracht [Packed things, brought family, neighbours, and friends to safety].

Helping others to prepare, evacuate, or take similar action was one major action that was not regretted by participants. Interestingly, even if these actions caused a threat to the person's own life, they were not regretted:

Aber ich stand auch bis zur Brust im Wasser um Leute da raus zu holen. Das würde ich wieder tun [But I was also standing up to my chest in water to get people out. I would do that again].

This helping behaviour and not regretting it may be explained by different psychological backgrounds, such as anticipating the guilt of not having helped someone in need because it may bring us pleasure to help others or because we have a moral responsibility to help others (Erlandsson et al., 2016).

3.4 Turning regret into future preparedness

Throughout participants' responses there are hints on how regrets related to (in)actions are paving the path for future preparedness. For instance, some participants intend to not trust or depend on local authorities and warnings due to the lack of received warnings. This will have a negative impact on (collaborative) risk governance (Ommer et al., 2024a). However, from a positive perspective, these participants now aim to be more proactive by taking measures in advance and being more attentive to the nature and the environment to detect changes to avoid surprises in the future.

Auf die öffentlichen Warnungen ist kein Verlass. – Kein Vertrauen in die Verantwortlichen. – Flucht – Selbst im Vorfeld alle Maßnahmen treffen um nicht überraschend zu werden [Public warnings are not reliable. No trust in those in charge – escape – take all measures in advance yourself to avoid being caught off guard].

Similarly, one participant implied regrets about their own knowledge and threat appraisal. In this case, the person perhaps did not have enough knowledge or information about what 200 mL of rain would mean and, thus, had to make decisions under greater uncertainty (Marchau et al., 2019). However, now, the person knows what 200 mL of rainfall means; thus, the person would be able to make better decisions in the future.

Jetzt ist man sich bewusst was 200 L m⁻² bedeutet. Bei ähnlichen Mengen hätte ich schon längst den Koffer gepackt und würde mich in Höhere Lagen in Sicherheit bringen [Now, one is aware of what 200 L m⁻² means. With similar amounts, I would have packed my suitcase long ago and would move to higher elevations for safety].

In addition, not taking warnings seriously and experiencing the flood caused participants to take warnings more seriously and take different actions next time. This learning from floods is very common and is acknowledged in research (Carone et al., 2019; Köhler et al., 2023; Kuang and Liao, 2020; Kuhlicke et al., et al., 2020b).

Moreover, intended behaviour changes imply that the flooding experience evoked a more proactive mindset. Increasing risk awareness and learning from flooding is a common process building on the reflections of past events (Kuang and Liao, 2020; Kuhlicke et al., 2020a). In this regard, one participant who had the responsibility of evacuating animals from the farm mentioned that it is important to have a plan for actions to be taken in emergency cases, which can be an easy step towards preparedness.

Einen Emergency Plan erstellen und dann durchführen [Create an emergency plan and then execute it].

Emergency plans and drills are considered stronger preparedness actions and, simultaneously, present proactive actions that can be implemented at any time, even without an imminent hazard (Katsikopoulos, 2021; Marchau et al., 2019). However, some participants believe that they could not have done anything to prepare for an event like the one in July 2021 and that it is only possible to respond reactively.

Das ist Naturgewalt, man kann nur reagieren [That's the force of nature, one can only react].

4 Discussion

The aim of this study was, firstly, to gain a better overview of the post-disaster (no) regrets of citizens and how these insights can support shaping a no-regrets approach to individual disaster preparedness. Hence, the following will discuss first the regrets and lack of regrets that were expressed (Sect. 4.1), second the effect of these regrets on future disaster preparedness (Sect. 4.2), and finally how the knowledge gained can shape the no-regrets approach (Sect. 4.3). Section 4.4 reflects on the limitations of this study.

4.1 Post-disaster regrets

Participants implemented various emergency measures to prepare their homes in a hurry, and they did not express any regrets related to the actions that they took unless those actions had life-threatening outcomes. Reversing this finding, it can be assumed that all actions that were taken somehow improved the overall outcome or at least did not have any negative effects. In the sense of “at least doing something” (Nalau et al., 2021), taking actions was not regretted, as people believed that they did (everything) that they could. In contrast, citizens regretted their inaction because, in a way, they

failed to prepare. Hence, considering the debate in the research about whether actions or inactions are more regretful (Feldman and Chen, 2019), we concluded that in this real-life experience (and contrary to previous research), inactions were regretted more. as participants perhaps wanted to take actions but could not because there was not enough time or other reasons.

Overall, the results highlighted the need to take the following actions in advance – basically from today onwards: develop an emergency plan including evacuation scenarios and learn to understand the environment better to be able to spot changes or to know what forecasted values will be like. These actions can be categorised as “strong” actions that can be taken well in advance. As we have seen, actions were not regretted when people perceived that they acted prudently or calmly. Unfortunately, in suddenly stressful situations, citizens do not usually act calmly or prudently if they were not prepared. However, in disaster situations, it is important to make well-informed decisions, which involves considering the potential outcomes of a decision (Sunderrajan and Albarracín, 2021; UNDRR, 2022). Therefore, we can conclude that short-term emergency measures are valuable and are not regretted, but long-term preparedness is even more important to be able to make informed decisions and be physically and psychologically prepared for surprise disasters.

4.2 Self-responsibility and trust for future preparedness

The survey responses indicated how regret has encouraged participants to take more responsibility, which is a typical effect of regret (Zeelenberg et al., 2002). Taking more responsibility was expressed in the context of acquiring knowledge on hazards; taking warnings more seriously; being more proactive in preparing, including short-term actions; but, foremost, in long-term actions such as emergency drills or plans. This shift towards proactive disaster behaviour is widely acknowledged in the disaster literature (Kuang and Liao, 2020) but has not yet been directly linked to regret.

Another factor causing the increasing self-responsibility of the participants is related to the decrease in trust in authorities, primarily due to the late or the lack of warnings. Trust is an important pillar of the relations between citizens and authorities, which is needed in emergency situations in particular (Earle, 2010). However, trust is very dynamic and fragile; thus, it is often observed that after a devastating event, the trust in authorities diminishes if expectations are not met (Seebauer and Babicky, 2018; Whitmarsh, 2008). This case was observed within the survey responses, which, on the one hand, reduces the dependency of citizens on public authorities but, on the other hand, can have an immense impact on future risk and disaster governance. Hence, it is important to move towards joint responsibilities and collective governance (Ommer et al., 2024a).

4.3 Implications of a no-regrets approach for individual disaster preparedness

The second aim of this research was to understand how these insights from citizens' regrets support the development of practical strategies for future (no-regrets) disaster preparedness. The following will discuss the main implications for designing a no-regrets approach for individual disaster preparedness.

Short-term preparedness actions (e.g. preparing the house, moving important items such as documents and photos upstairs, storing food) taken by participants were not regretted; thus, they can be categorised as no-regrets actions (also because they are easy to implement and are low cost). Furthermore, as inaction was largely regretted, these short-term actions were perceived as better than doing nothing. In the literature, short-term actions were referred to as weak actions (Katsikopoulos, 2021), but they are not useless, as none of the participants regretted having taken them. However, more awareness needs to be raised regarding the fact that taking these measures at the very last minute, such as preparing the basement when flood water is already intruding, can pose a threat to life and, therefore, can become regrettable.

However, as we have seen, some participants suggested moving towards long-term preparedness actions for the future including developing emergency plans or conducting drills, gaining knowledge, and being more attentive to the environment. In this sense, it can be argued that these actions are stronger actions, as was claimed by Katsikopoulos (2021). Nonetheless, whether they are weak or strong actions, all the actions listed by participants can be categorised as no-regrets actions for individual disaster preparedness.

However, (long-term) no-regrets actions should also focus on the psychological preparedness of citizens. As surprising and stressful situations can cause reflexive behaviour, it is important to be psychologically prepared to stay calm and act rationally (APS, 2018).

In addition, many actions that were taken in advance of the flooding were focused on helping others in various situations, and people did not regret these even if their own life was at risk. This finding acknowledges the importance of supporting family, friends, neighbours, and even unfamiliar people. In response to this finding, individual long-term preparedness could be enhanced by focusing on collective action.

Furthermore, actions need to create a feeling of awareness, responsibility, and independence. Citizens were greatly dependent on authorities during this flooding event (Ommer et al., 2024a). This dependency and their trust in authorities to manage the flooding caused great regrets when the expectations were not met, which created a difficult situation for the participants. This is also a common issue in other countries, i.e. in England (Cologna et al., 2017; Thorne, 2014). To anticipate the impasses citizens were in and to avoid increasing distrust in authorities, actions should support the creation of awareness of risks, should build environmental knowledge,

and should loosen dependencies of citizens while increasing their feelings of responsibility.

Overall, actions need to be within the abilities of citizens, as the results showed that citizens have taken actions that lie within their abilities and in some cases had to give up. Therefore, it can be argued that the no-regrets approach can be influential, as these actions shall be within the abilities (psychologically, physically, and financially) of citizens but further shall have co-benefits even under great uncertainty (Heltberg et al., 2009).

Summarising the findings, we highlighted the fact that citizens need to be motivated to take long-term preparedness actions in order to cope with future (unexpected) hazards and their impacts. The findings of this study suggest that the no-regrets approach could be a suitable framework, combining short-term (emergency) preparedness and, foremost, long-term preparedness due to the robustness of actions in different scenarios, the no-regrets factor in case no hazard ever happens, and its motivational elements. However, in addition to the characteristics introduced and in order to ensure that actions are taken and not regretted, the findings of this study showed that no-regrets actions must be easy to implement; thus, citizens are able to take them, and it supports the idea of collective action as a motivational and enhancing factor for individual preparedness and self-responsibility, respectively.

Overall, this study has highlighted the fact that regret and the experience of a flood can increase future preparedness, which is similar to a large number of findings from other studies. However, the question is whether we really need to experience and regret flooding first before starting to consider long-term preparedness. One major barrier to individual disaster preparedness is low risk perception (Kuhlicke et al., 2020a; Bubeck et al., 2012), which further includes limited imagination of potential disasters (Ommer et al., 2024b). Thus, citizens without prior disaster experience (and regret) may lack the motivation to prepare themselves for potential hazards, especially from a long-term perspective.

4.4 Limitations and implications for future research

This study focused on the regrets expressed by citizens affected by the floods in Germany in 2021. The study design unveiled several limitations that need to be acknowledged at this point. Firstly, regret is highly subjective since it is an emotion resulting from one's own reflection on the past. Within this paper, we aimed to include regret that was expressed explicitly but also implicitly. Hence, the primary limitation of the study is that evidence regarding the degree of regret is lacking. Secondly, as this study builds on a survey, an external validation of the results is not feasible, and deeper questions regarding the responses could not be asked. Therefore, we can suggest that future research apply mixed methods (e.g. survey and a follow-up focus group discussion). Thirdly, the dissemination of the survey using social media may have excluded some participant groups that were

not using any of these channels. Despite this bias, the study represents the age structure of Germany.

5 Conclusions

This study explored the flooding event in Germany in 2021 from the perspective of post-disaster regret to gain a deeper understanding of citizens' (no) regrets regarding disaster preparedness actions to derive lessons learnt for the application of the no-regrets approach for individual disaster preparedness.

The findings of the survey of citizens affected by the flooding event showed that regret can primarily be associated with inaction (instead of with actions), which contrasts with psychological studies from fields other than disaster science. Furthermore, the responses showed that the citizens affected learnt from their experiences (and regret) and instead pursued long-term preparedness for the future, but they noted that short-term preparedness is not regrettable and, hence, is non-neglectable. However, the importance of long-term preparedness, including emergency plans/drills, acquiring hazard information, attentiveness to nature, and especially psychological preparedness, are highly valuable, allowing us to stay calm and act prudently in (sudden) stressful situations.

The insights into non-regretted actions can help to shape a no-regrets approach for individual disaster preparedness, which is lacking to date. Hence, building on this study, the no-regrets approach can pave the way towards long-term preparedness of the citizens, but more research is needed on how to facilitate citizens walking this way.

Data availability. The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research, the survey data are not available.

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