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**Here to Stay or Move Away? – Investigating the Impact of Climate
Change-Related Natural Disasters on Migration Decisions**

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Abstract

The impacts of climate change on migration are expected to dramatically shift existing paradigms in the field of human mobility studies. As trends indicate the intensification of the adverse effects of climate change, so too are related climate displacement and migration forecasted to develop into a full-blown international crisis. In the face of these developments, this paper contributes to climate migration research by uncovering how the effects of climate change-related natural disasters form migration decisions, using Germany's deadly 2021 Ahr Valley flood for an in-depth and scholarly study. Synthesizing an analysis of the flood event and interviews with flood victims results in findings that suggest that if those affected by the flood had extensive local social networks, received sufficient government aid, and did not suffer adverse health effects, the likelihood increased that they would remain in the Ahr Valley despite the elevated risk of such a flood event reoccurring in the future and the appending costs thereof. These results provide policymakers with insights they can use toward policy designs that alleviate the adverse effects future climate migration is predicted to carry.

Climate Change-Induced Displacement: A 21st Century Challenge

What do fishermen in coastal Senegal, farmers in Mauritania's rural inlands, and residents of a valley in Western Germany have in common? They all sit at the forefront of a worsening trend increasingly observed in the field of migration: climate change-induced displacement. Whether due to an encroaching sea, intense droughts, or devastating floods, the United Nations High Commissioner on Refugees (UNHCR) estimates a yearly average of over 21.5 million people have been displaced by slow or sudden onset climate and weather-related hazards since 2008. Comparatively, conflict-and-violence-induced displacements, both domestic

and international, amount to less than half that number over the same period (figure 1) (UNHCR 2021a).

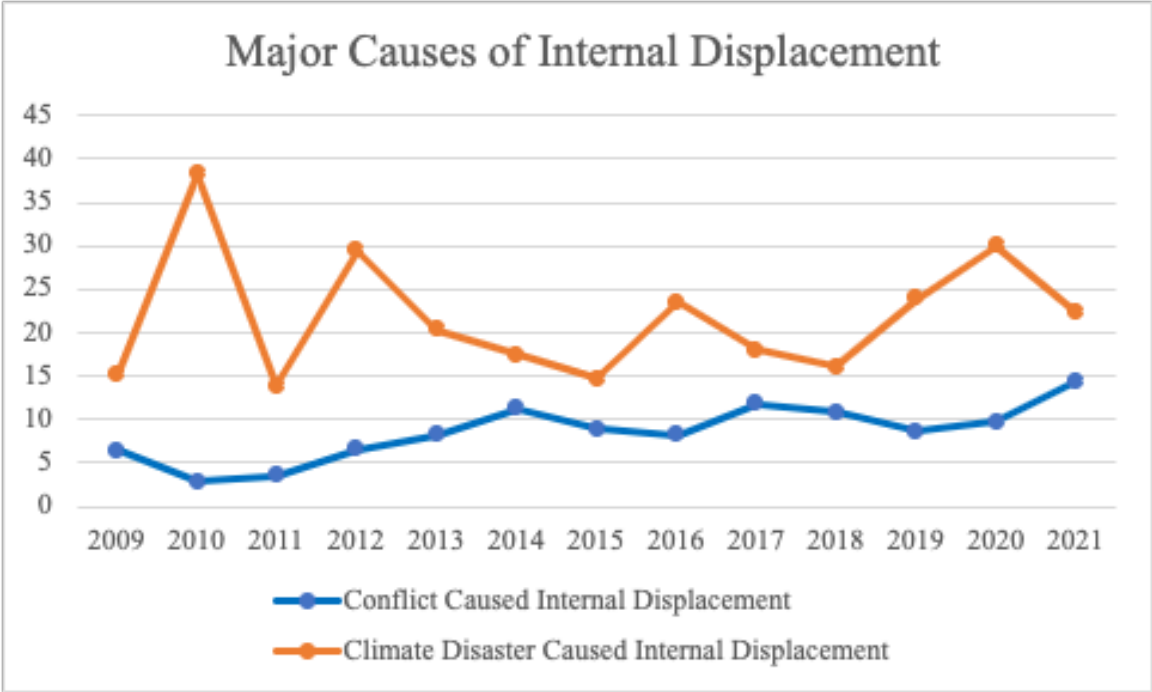


Figure 1. Graph comparing year-over-year (x-axis) internal displacement numbers in millions (y-axis) by displacement cause using data from the Internal Displacement Monitoring Centre’s 2021 Global Internal Displacement Database. Graph by author.

Meanwhile, scientists have confidently stated that “through displacement and involuntary migration from extreme weather and climate events, climate change has generated and perpetuated vulnerability” (IPCC 2022, 11). However, while the consensus that climate change influences migration is growing, not all climate change-induced displacement is compulsorily permanent; neither is climate change a prominently unique contributor to displacement. To illustrate, persons affected by climate change-aggravated natural disasters may decide to rebuild and reside in a disaster-struck area once the danger has passed. Nevertheless, per the

Intergovernmental Panel on Climate Change (IPCC), up to 143 million people could migrate due to climate change-induced displacement by 2050 (IPCC 2022, 65). Even the lowest IPCC estimates dwarf the largest mass migration in human history when ten million people were displaced due to the 1947 partition of India (Bates 2011). Considering the fact that 1.3 million migrant arrivals caused a pan-European crisis in 2015, it is salient to understand the factors and possible patterns that contribute to climate change-induced displacement and associated migration decisions to best prepare for and mitigate this anticipated and unprecedented mass migration (Connor 2016, 4). Essentially, hundreds of millions of livelihoods are at stake, affecting everything from local and international economies to national and international security. This, combined with evident time pressure, makes the issue not only one of high practical relevance but one that needs to be addressed without delay. In the words of UNHCR Head Filippo Grandi, “Waiting for disaster to strike is not an option” (UNHCR 2021b). Yet, the precursors of this disaster have already started manifesting and wreaking havoc across the globe. Even in Germany, consistently ranked as one of “best countries to escape the worst effects of climate change,” climate change-related weather events have caused devastation so great human mobility was induced (Brodwin 2018; Büngen 2022; Somvichian-Clausen 2020). One such event was the 2021 Ahr Valley flash flood in the western German state of Rhineland-Palatinate (*Rheinland-Pfalz*), which occurred as part of the larger 2021 European floods. Caused by unusually high levels of persistent, heavy rain between July 12 and 15, 2021, these floods led to widespread damage and casualties in several countries. Over half of these casualties, at least 134, occurred due to the aforementioned Ahr Valley flash flood between the afternoon of July 14, 2021, and the early hours of July 15, 2021, making it one of the worst natural disasters by death toll Germany has seen in over 50 years (Weidinger 2022). By analyzing this disaster and

interviewing persons affected by it, this paper seeks to answer the question: How do the effects of climate change-related natural disasters impact the decision to migrate away from disaster-struck areas?

Scholarly and Practical Relevance

Scholarly research is needed to best assess the future extent of climate migration and figure out how we can devise appropriate solutions to the problem. While the IPCC estimates a maximum of 143 million people to be climatically displaced by 2050, the Institute for Economics and Peace projects this number to be 1.2 billion (IPCC 2022, 65; McAllister 2023). Yet, such vastly different estimates translate into inevitable systematic changes to policy solutions. While an unprecedented challenge, handling 143 million migrants remains easier than handling 1.5 billion. Scholarly research on what influences climate change-related migration decisions and which threshold has to be crossed for people to migrate due to climate change-related natural hazards could help narrow the prevailing gap in estimates. Furthermore, as climate change and migration scenarios vary by location, international scholarship by researchers familiar with the socio-economic actualities of the places experiencing climate migration provides greater insight into localized challenges and policy responses. By expanding this scholarship, this paper can help us uncover potential patterns in climate migration that sequentially help create predictions for this multifaceted form of human mobility. Such predictions can help us assess conceptions ranging from which climatic changes particularly aggravate displacement to the potential migration streams and migrant networks that develop due to climate change-induced displacement.

By using the 2021 floods in Germany's Ahr Valley and the ensuing migration for an in-depth study, this paper will contribute to scholarly literature that deals with internal climate migration in the Global North. Indeed, while climate migration remains a nascent field of research to which this paper seeks to contribute, the Global North receives comparatively little attention regarding the topic, which is coherent, considering the Global South is most vulnerable to climate change (Hoffmann et al. 2021, 3). Still, research on the Global North remains invaluable.

The central argument, which is supported by the interviews to follow, is that if governments enforce adequate mitigation and adaptation mechanisms in response to climate change and related natural disasters, persons and communities will be less prone to leave the affected area, but rather remain immobile and rebuild.

This paper will proceed with a literature review on how climate displacement impacts the vulnerability of those affected in the Global South, how we can achieve justice for the displaced, the challenges of accommodating climate migration in global governance paradigms, and the relation between climate displacement and national security. The section thereafter will briefly detail the qualitative methods used to assess the impact the Ahr Valley flood had on the migration decisions made by those it affected. An analysis of the events that unfolded in the Ahr Valley in 2021 will be conducted, looking at the lead-up to the flood, the flood itself, and its aftermath. This will be complemented by an assortment of semi-structured in-person and online interviews that were conducted with experts to assess living conditions in the Ahr Valley pre and post flood. Also, persons affected by the flood were interviewed on their decision to stay or leave the valley after the flood to uncover the motivation behind their respective decisions. Afterward, the results of the assessment are discussed before the conclusion addresses what migration

decision-making in the Ahr Valley can teach us about climate migration and how future research can help us better understand the complexities of climate change and human mobility.

Literature Review

As I posit in this paper's literature review, the majority of academic writing, irrespective of whether it deals with vulnerability, climate justice, global governance, or national security, is unified in that it demands specific measures from international actors to respond to issues of climate migration. This means that while the insights countries can provide on climate migration as a result of their own experiences, regardless of whether they address specific demands, are certainly not ignored, they appear to be less prioritized. Accordingly, this paper seeks to contribute to the literature, which is to be reviewed, by offering a critical perspective on lessons learned from climate disaster-induced human mobility/immobility rather than demanding particular action.

Vulnerability in the Global South

As aforementioned, the Global South appears of higher academic interest than the Global North when analyzing published literature on climate migration. In fact, were we to use the Brandt Line, which remains largely unchanged since its 1980 conception, as a demarcation between the two regions, the majority of studies on climate migration would be attributable to the Global South (Lees 2021, 85, 87). This is corroborated by Hoffmann et al. (2021), whose analysis of 127 quantitative climate migration studies finds research focuses on the Global South (3). Particularly, African and Asian countries are mentioned in academic literature due to their unprecedented vulnerability to climate change. The EM-DAT database on international disasters

indicates 187 million persons were affected by climate disasters in Africa between 1999 and 2010, with geographic and economic variables contributing to disaster exposure (Busby et al. 2013, 136-137). Evidently, limited infrastructure and financial resources prevalent in the Global South hamper developing countries and their inhabitants in their climate change adaption and mitigation faculty. Consequently, more people will face the full brunt of the adverse effects of climate change, including displacement and its consequences. For instance, a lack of financial resources means those who cannot avoid being displaced by climate change are further exposed to illness in the aftermath of their displacement. In Bangladesh, where negative geographic and socio-economic variables have spurred the climatic displacement of millions of people, the overwhelming majority of displaced persons cannot afford out-of-pocket medical treatment. Concurrently, the need for medical treatment is set to increase as climate change-induced weather extremes escalate the likelihood of ailments, ranging from heat stroke to waterborne illness (Chowdhury et al. 2020, 1, 8; Jayawardhan 2017, 127). Therefore, we need to ensure that countries and individuals with limited financial resources use their assets for appropriate adaption or mitigation mechanisms in an attempt to avoid climatic displacement and its repercussions in the first place. Paradoxically, limited resources, both financial and social, can inhibit leaving a place of abode in the face of intensifying climate disasters, as travel becomes increasingly difficult and the prospect of receiving assistance on the journey remains bleak (Findley 1994, 541; White 2019, 135; Zickgraf 2018, 72-73).

While climate migration literature's focus on the Global South might initially make sense due to this region's increased vulnerability, I argue that excluding the Global North from this research might equate to deliberately disregarding an opportunity. By averting our gaze from the Global North, we neglect to research adaption and mitigation mechanisms in countries that can

afford to test their effect on displacement prevention. While the effects of climate change are known to vary depending on locality, testing the macro-level effectivity of mitigation and adaption strategies in the financially capable Global North can help us deduce whether they are even worth spending money on in the Global South (Busby et al. 2013, 152).

Climate Justice

The disparate financial resources available to tackle climate change further tie into a discussion on justice for climatically displaced persons (CDPs). Financially well-endowed countries have emitted high amounts of climate change-spurring greenhouse gas (GHG) emissions to generate high human development and wealth that can be used to reduce vulnerability to climate change (den Elzen et al. 2013, 400; Kuusipalo 2017, 625). Concurrently, the Global South, with limited financial resources and lower human development, is disproportionately threatened by climatic displacement exacerbated by the Global North's emissions (Cattaneo et al. 2019, 194). It is in this context that normative theorists believe it is only just for developed countries to be ascribed responsibility for climatic displacement in the Global South. Out of self-interest, countries fulfill commitments in the most minimal way possible, requiring the conception of a set of minimum obligations developed countries have toward people to whose climatic displacement they contributed (Draper 2018, 59-60). Though theorists agree that CDPs are owed justice, they disagree on whether CDPs should be addressed individually or collectively. Furthermore, the actors who owe the aforementioned justice and the way they can enact it are disputed. While some theorists insist developed countries are required to repay the harm faced by CDPs, others defend the position that any actor who does not reduce GHG emissions despite knowing the harm they cause should be held accountable for climatic

displacement (Buxton 2019, 194). Repayment can take various forms, ranging from developed countries granting asylum to CDPs if these persons deem it the best solution to remedy their displacement to monetary compensation and the provision of land to collectives (Buxton 2019, 212, 215-216; Draper 2018, 72).

While existing literature addresses normative commitments to either individual-level international climatic displacement or larger groups of displaced persons, its content cannot be fully applied to the individual circumstances of internally displaced persons. Therefore, contributing to research on internal displacement under consideration of individual narratives is salient to expand the data normative theorists can use to devise commitments toward persons internally displaced by climate change (McLeman 2018, 333).

Etymology and Global Governance Frameworks

Whereas normative theory is occupied with responsibility toward climate migrants, a sizeable literature has developed on the appropriateness of applying the term ‘refugee’ to persons displaced by slow- or rapid-onset climate change as well as their accommodation in international paradigms. Their classification as ‘refugees,’ similar to the term’s definition in the 1951 Refugee Convention, would ascribe them rights and protections per legal and global governance frameworks for which they are currently ineligible (Francis 2019, 124-125). Yet, scholars are split on whether to ascribe refugee rights to CDPs in international frameworks.

An argument against the ascription of such rights is that climate change is not the sole contributor to migration, raising the question why it would be considered the key factor in migration decision-making if other factors are equally important (McAdam 2011, 12, 15; Jayawardhan 2017, 104-105). Therefore, creating an international framework around climate

migration and displacement may overemphasize the role of climate change in displacement and lead to increased disagreement between negotiating parties (McAdam 2011, 6). Even if an international treaty guaranteeing protection to climate migrants was drafted, its enactment could be protracted (Dawson and Laut 2021, 48). Also, putting an extended effort into creating a treaty means neglecting the creation of displacement-preventing adaption and mitigation policies (McAdam 2011, 5). As the needs of over ten million recognized convention refugees have yet to be addressed, this begs the question whether it is sensible to further designate millions of climate migrants as refugees (Jayawardhan 2017, 109; McAdam 2011, 16). Experts also fear that renegotiating the refugee convention can strip it of its legitimacy and weaken its current protection of refugees (Kuusipalo 2017, 630). Furthermore, as the convention only protects cross-border migrants, the previously established fact that most climatic displacement takes place within countries would not be addressed by simply expanding the refugee convention (Jayawardhan 2017, 110; Kuusipalo 2017, 630). Hence, creating regional and domestic solutions for climate migrants may be superior because they can be more accommodating of local circumstances (Francis 2019, 127; McAdam 2011, 4).

Opponents argue for the global governance of climate refugees, partially claiming progress has been made on the international scale as organizations like the United Nations Environment Program have developed definitions of ‘environmental refugees’ that partially apply to persons displaced by climate change-induced weather extremes (Biermann and Boas 2010, 62; Kent and Behrman 2018, 44). Climate migrants should be treated as part of the larger environmental migration movement as they suffer from harm that can only be sufficiently addressed through the ascription of a refugee status (White 2019, 137). After all, they are suffering displacement, similar to refugees protected by the refugee convention (Jayawardhan

2017, 107). To better achieve consensus on refugee status ascription, proponents of this view argue for strict limitations on what qualifies someone as a climate refugee. Accordingly, persons who are not forced to migrate due to climate change cannot claim climate refugee status, just as little as persons who are displaced by environmental pollution and climate change mitigation or adaption projects (Biermann and Boas 2010, 63-64). In this, they clash with authors who believe development-induced displacement resulting from mitigation and adaption projects is salient enough to be included in existing protections for CDPs (Adeola and Viljoen 2018, 336, 349). Those who argue for the inclusion of persons displaced by climate change mitigation and adaption are proponents of an “adaptive approach,” which seeks to prevent displacement via pre-established clauses and laws (Adeola and Viljoen 2018, 341, 344; Dawson and Laut 2021, 49).

Climate Migration and National Security

Despite the forecasted geopolitical destabilization caused by climate migration and discussions on how to handle climate migrants, some researchers are skeptical of links between climatic displacement and a threat to national security. Quantitative analyses have found no statistically significant relationship between climate migration and an increased conflict likelihood, and migrant destinations are able to conduct conflict prevention within their borders through measures of recourse (Cattaneo and Bosetti 2016, 18). Nevertheless, it should be acknowledged that social unrest might develop in destination countries if migrant arrivals spike. This unrest can be compounded by unfavorable socio-political and economic circumstances, which increase the likelihood of crimes committed by and against climate migrants (Ibid.). As climate migration from developing to developed countries is bound to increase, the likelihood of unrest will also rise (Marotzke et al. 2020, 525). Yet, even when conflict and climate migration

are connected, scholars from the Global North might not deem this a threat to national security as the regions affected by these conflicts lay far from their homelands and are of little direct “interest” to them (Levy 1995, 37). This argument does not hold strong nowadays as new power dynamics between the Eastern and Western worlds spur competition for influence in the developing countries and regions most affected by climate migration. Thus, I argue that should affected countries ally with rival Eastern regimes, countries like the United States will perceive a threat to national security, increasing the likelihood of an aversive American intervention. Finally, security scholars who argue against the salience of climate migration in national security on the basis of conflict spurred by international migration seem to underestimate the domestic effects climate change and linked migration can have on national security (Levy 1995, 46). Despite high human development, domestic populations can be harmed or killed by climate extremes in the Global North, leading to potential internal displacement. Considering the safety of a country’s citizens is of utmost concern to national security, as proclaimed by government experts and national governments, it appears abstruse to claim threats to human health caused by climate change and climate displacement are not relevant enough to be deemed threatening to national security in the Global North (Levy 1995, 52; Longley 2021; The White House 2022).

Addressing the Gap in Literature

The Global North has been less of a focus of mainstream academic literature despite its salience to the discussion on climate migration, which can positively influence policy development in the Global South. By focusing on the Ahr Valley flood and the impacts thereof on human mobility, a case which has never been empirically studied, this paper will contribute to filling a gap in academic literature and provide data that can be used for climate migration-

related decision-making. By interviewing internally displaced persons in the Global North and uncovering how the effects of climate change-related natural disasters impact the decision to migrate away from disaster-struck areas, the data this paper will provide can be used to expand the literature on climate justice and how to achieve just solutions for individuals who have been internally displaced by climate change. As for decision-making on whether or not to handle climatic displacement globally or regionally, the information provided by this paper can be used to rationalize or contradict the respective approach, while the devastation and displacement the Ahr Valley faced in the aftermath of the flood will show the relevance of climate change-induced displacement to national security in the Global North, thereby opposing arguments made in existing literature.

Methodology

As aforementioned, the methodology used for this paper revolves around an in-depth and scholarly study of the Ahr Valley, which provides information on the initial geography and economy of the region and details the events that unfolded on the night of July 14 and July 15, 2021, as well as the relation in which they stand to manmade climate change. The study will be supplemented by statements and narratives selected from 10 semi-structured, open-ended, in-depth interviews that were conducted in person in the Ahr Valley and the cities of Koblenz and Mainz in March 2023 as well as online during the same timeframe. Semi-structured interviews are viewed as “superbly suited” to collect individual opinions and sentiments on a given topic as they use a guiding set of interview questions and give leeway to follow-up queries that permit interviewers and interviewees to deviate from questionnaires when deemed relevant (Adams 2015, 493-494). In combination with the in-depth study, the diverse personal narratives,

perceptions of the flood by affected individuals, and expert insights gathered in these conversations provide the information necessary to conduct an analysis that helps determine the factors that influenced migration decision-making in the aftermath of the 2021 flood disaster.

Snowball sampling, by way of the referral of email addresses and telephone numbers, was used to identify and contact nine of the ten interview partners, with the tenth person having been contacted by way of convenience sampling. While convenience and snowball sampling were used as they facilitated entering into dialogue with a hard-to-reach population that has a general disinclination to discuss the flood event, it should be mentioned that these sampling methods are vulnerable to sampling bias (Heath 2023). Still, an effort was made to counter sampling bias by using three unrelated individuals as starting points for snowball sampling.

Out of the ten interviews, eight were conducted in Standard German, whereas two featured code-switching between Standard German and Moselle-Franconian/Luxembourgish. Nine of the interviews ran between one and two hours, and one lasted four hours as it included a guided tour of a flood-hit town given by the interviewee.

With regard to the interviewees, nine, including one expert, were affected by the flood, experiencing economic and/or personal damage, while a second expert did not suffer any damage whatsoever. Still, the latter's employment was affected by the disaster as most of their work shifted to assisting in the Ahr Valley's reconstruction.

As German and European Union laws impose restrictions upon interviews with consenting participants aged 17 years or younger, the interview sample was limited to persons 18 years of age or older. Furthermore, in accordance with the European Union General Data Protection Regulation and University of Chicago Institutional Review Board guidelines, interviewees had to give verbal consent to conduct the interview and written consent to transfer,

process, and use the interview data outside the European Union. Correspondingly, to ensure the ethicality of the research, interviewees were asked for consent to use their real names in this study. If consent was denied, they were coded by occupation.

Perusing the Ahr Valley

Valley Geography

To better understand the events surrounding the Ahr Valley flood, it makes sense to provide a brief description of the valley's physical and human geography. Located in western Germany, the valley snakes its way a total of 89 kilometers (55 miles) from the Belgian border to the Rhine River, dropping 421 meters (1,381 feet) from its highest point in the west to its lowest by the Rhine. Flowing through the valley is its namesake "Ahr" River, fed by several streams and shallow enough to be crossed by foot in the upper valley, which ranges from the municipality of Blankenheim to Insul (figure 2). The upper valley is characterized by rolling hills and pastures spanned across a relatively wide area. Further east lies the central valley, known for its narrow ravine topography, commencing near the town of Hönningen and ending just short of Walporzheim, as seen in figure 2. It is in this central portion that the Ahr River, which has an average overall depth of one to two meters (3.2 to 6.5 feet), reaches some of its deepest points, though it rarely exceeds depths of over two meters (6.5 feet). Finally, the valley floor reaches its widest section in the lower valley commencing in Walporzheim and ending at the confluence of the Rhine and Ahr rivers at Sinzig. It is also in this section of the Ahr Valley where the most populous settlement on the river Ahr, the city of Bad Neuenahr-Ahrweiler, can be found (figure 2); 27,743 of the valley's 75,000 inhabitants call this city home (Ihrlich et al. 2022; Kreisverwaltung Ahrweiler 2021a).



Figure 2. Map of the Ahr Valley. Map by Rhein-Eifel TV, edited by author. 2021.

Valley Economy

The Ahr Valley’s local economy is largely driven by tourism and viticulture – the cultivation of wine. Over 65 of this region’s wineries operate on a year-round, full-time schedule, with the most profitable ones each generating 50 million euros in turnover per year (Dollase 2021). Typically, the Ahr Valley vineyards are located on its steep slopes, while wine production, processing, and operations take place in wine cellars in the towns on the valley floor. In total, vineyards use up 563 hectares of the valley’s available land area (Ihrlich et al. 2022). Wine also plays a big role in the region’s tourism industry as many guests visit for so-called ‘wine hikes,’ during which they tour the wineries across the valley. In 2019, the Ahr Valley tourism office recorded approximately 1.4 million overnight stays, with Bad Neuenahr-Ahrweiler being a particularly popular destination, accounting for just over half the aforementioned stays and 450 of the region’s “touristic businesses” (Ibid.; Statistisches

Landesamt 2019). As one of Germany's most popular *Badestädte* – spa towns – Bad Neuenahr-Ahrweiler thrives off wellness tourism, and its economy is boosted by its status as a popular place to retire. The latter is reflected in the city's age demographics as people 55 years or older made up 46.9% of the total population in 2020, and the average age was 48.7, over four years older than the German population's average age and 2.7 years older than that of Ahrweiler County's population, Ahrweiler County being the larger administrative division home to the Ahr Valley (Destatis 2020a, Destatis 2020b, Bundesinstitut für Bevölkerungsforschung 2021).

The Ahr Valley Flash Flood: Chronology of a Disaster

In the face of the 134 lives lost that summer night in 2021, perhaps, the most surprising aspect is that there was ample warning to prepare for the flash flood and evacuate the area. Three weeks before the disaster, ongoing rainfall led to a saturation of soil in Rhineland-Palatinate with “free soil water storage” falling below one centimeter (0.39 inches) (Kreienkamp et al. 2021, 4). The first signs of potential danger were picked up by a satellite nine days prior to the flood (Moody 2021). As more data became available in the days after the initial satellite detection, scientists from the University of Reading warned of an “extreme rain” event with a pinpoint location in western Germany four days before disaster struck (Cornwall 2021). This was followed by an “‘extreme’ flood warning” that was issued to the German Meteorological Service (DWD) by the European Flood Awareness System in the week of the Ahr Valley flood (Mathiesen et al. 2021). Yet, affected residents did not receive any official government warnings prior to July 14, 2021, and neither did the impending flood risk get national media coverage in the run-up to the event.

On July 12, 2021, the predicted rain event commenced, saturating the remaining millimeters available for free soil water storage and leading the European Flood Awareness System to declare the highest possible alert level. A partner of the pan-European initiative, DWD was notified of this alert the same day and issued a public storm warning and an adjunct persistent heavy rain warning for western Germany. However, German law prohibited DWD from issuing a public flood warning as this responsibility falls under the exclusive mandate of state government institutions; in Rhineland-Palatinate's case, this institution is the State Office for Environment (*Landesamt für Umwelt*) (Weidinger 2021). Still, DWD notified the respective government entities of the flood risks in anticipation of the government forwarding these alerts to the public. As no such alerts were raised, DWD sounded the public alarm on an extreme hydrological event in the Ahr Valley region, stating the area "is expected to see the highest amount of precipitation" (Ibid.).

Precipitation picked up in the early hours of July 14, 2021, leading the Rhineland-Palatinate State Office for Environment to increase its alert level to its second-highest at around 11am. Yet, no public warning was issued to the residents of Ahrweiler County by the state or local governments. Instead, the only persons who were warned at this time were those who had downloaded an application called *Katwarn* on their phones (Ibid.). As of January 2023, 3.8 million people, or 4.5% of Germany's population, had downloaded *Katwarn*, a number that likely was lower in 2021 and particularly low amongst the older-than-average and less technology-savvy Ahr Valley population (Stiftung Warentest 2023). Half an hour later, the state government's internal flood situation report was updated to warn of significant flooding along the Ahr River, causing some "concern" amongst officials but not enough to require further action (Weidinger 2021). Several hours later, at 2pm, a draft press release of the situation report was

forwarded to the respective government entity for approval. In the meantime, the river's water level continued to rise, quickly rendering the aforementioned report obsolete. Yet, it is this draft that would be given the green light for release around 5pm, when flooding had commenced in the upper reaches of the valley, uprooting trees along the river and crashing them into bridges, effectively creating dams. In the meantime, municipal government leaders in the Ahr Valley had urged the Ahrweiler County government to declare a state of emergency in order to adequately warn and evacuate those in the path of imminent danger, but to no avail (Ibid.). Again, German law prohibited municipal leaders from giving the orders themselves. At 5:17pm, the State Office for Environment raised the alert to the highest possible level, leading to a second Katwarn notification but no other public warning. It is at this point that the Ahrweiler County government issued the outdated press release based on the 11am water levels (Seidel et al. 2022).

Concurrently, the state government started sending mixed signals by reducing predicted water levels, leading officials to assess the situation as under control and assure the state's interior minister that "all necessary precautions were put in place" at around 7pm (Weidinger 2021).

Minutes later, the dammed bridges gave way in the upper valley unleashing a torrent of water approximately seven meters (~23 feet) deep upon the valley below. The first houses were flooded, and people were carried away by the water. At just before 9pm Insul, the final town in the upper valley (figure 2), was hit by the flash flood, tearing houses from their foundations. The first reports of the destruction in the upper valley and calls for aid reached Bad Neuenahr-Ahrweiler's regional emergency management center at 9:30pm (Weidinger 2021).



Figure 3. Photograph of a house destroyed by the flash flood in the upper valley municipality of Müsch. Photograph by author.

The flood wave worsened as it passed through the central valley due to the narrow lay of the land, leading to reports of a flash flood that was officially estimated at ten meters (~33 feet) high after the water level measuring station in Altenahr (figure 2) was torn away by the torrent (Hochwasservorhersagedienst Rheinland-Pfalz 2023). Altenahr would report 33 casualties in the aftermath of the flood (RedaktionsNetzwerk Deutschland 2021). Soon thereafter, Dernau was hit by floodwaters that reached the second floor of houses 350 meters (~1150 feet) from the

riverbed. Finally, the Ahrweiler County government declared a state of emergency at 11:15pm, prompting the mobilization of rescue services and the German army (Weidinger 2021).

However, despite the extent of flooding in Dernau, evacuation orders were only given to residents of Bad Neuenahr-Ahrweiler, Bad Bodendorf, and Sinzig (figure 2) whose properties lay less than 50 meters (164 feet) away from the river (Kreisverwaltung Ahrweiler 2021b). The remaining residents were asked to remain at home and proceed to a higher location in their residences “should the need arise,” per a Facebook post as well as a written statement on the county website (Ibid.). No sirens were sounded in any part of the valley, meaning that most people, asleep or awake, remained oblivious of the flash flood over three hours after the first municipalities in the upper valley were hit. As a result, the majority of lower valley residents were caught off-guard when the flash flood arrived in their towns and cities, and it would be in these localities that the most deaths would incur. Bad Neuenahr-Ahrweiler lost 69 residents, while Sinzig, the town at the far eastern end of the valley, lost 13 people, 12 of whom lived in one single building and were surprised by the water in their sleep. These final casualties were suffered at two in the morning, over six hours after the first buildings were carried away in the upper valley (RedaktionsNetzwerk Deutschland 2021; Weidinger 2021). It is also important to note that 106 of the 134 dead, i.e., the overwhelming majority, were people aged 60 years or older, their limited agility making them one of the most vulnerable demographics with regard to flash flooding (RedaktionsNetzwerk Deutschland 2021).

The Role of Climate Change

The Ahr Valley is no stranger to flooding. In fact, prior to 2021, the region experienced major flooding at such regular intervals that the floods have been termed as

Jahrhunderthochwasser – 100-year floods – by locals, with the most recent ones taking place in 1804, 1888, 1910, and 2016 (Kreienkamp et al. 2021, 5). Once the 2021 flash flood had passed, it too was termed a “*Hochwasser*,” the German word commonly used for flooding that occurs when river waters gradually rise, indicating that the flood was perceived as nothing extraordinary of further future concern. Yet, this was not the case. Rather, the flooding that occurred in 2021 was unprecedented in its intensity and probability. As was the case in 1910, the 2021 event occurred sooner than ~100 years after the last significant flood event and at nighttime. As was the case in 1804 and 1910, a wall of water tore through the valley with such intense force that bridges and houses were torn away (Janta and Poppelreuter 2010, 188, 192). However, the 2021 flood was more lethal than all the previous floods combined, and while one of the reasons for this is the higher population density and older population age in the lower valley compared to 1804 and 1910, the lethality can also be attributed to the flood’s higher than average intensity due to climate change (Kreienkamp et al. 2021, 1). Specifically, climate scientists found the rainfall event preceding the flood to be up to 19% more intense than if it would have taken in Western Europe in a “global climate 1.2°C cooler than today,” i.e., the climate during pre-industrial times (Ibid.). Consequently, the higher rainfall intensity led to higher amounts of floodwaters rushing through the valley at record-breaking speeds. At the time the measuring station in Altenahr was destroyed, the Ahr River’s discharge had reached 555m³/s and estimates calculate the peak flow at Altenahr to have reached 1000m³/s (+/- 200m³/s) in the early hours of July 15, 2021 (Ibid., 9.) Scientists also found a high likelihood that this value was exceeded further downstream in Walporzheim, where the peak flow is estimated to have reached 1200m³/s. To put the intensity of this flood event into perspective, the discharge on an average day and the highest ever recorded peak flow at Altenahr’s measuring station prior to the 2021

disaster, which was measured during the 2016 flood, were 6.86m³/s and 236m³/s, respectively (Ibid., 10; Hochwasservorhersagedienst Rheinland-Pfalz 2023).

Similarly, global average temperatures 1.2°C (2.1°F) higher than pre-industrial times aggravated the likelihood of the heavy rainfall event that led to the flood by a factor of up to nine (Ibid., 1). As of January 2023, AI models predict global average temperatures will increase by a further 0.8°C (1.4°F) by 2060 (Garthwaite 2023). Following these predictions, it is expected that if such an event were to occur in 2060, it would be 6% more intense compared to 2021, while the likelihood of a similar event occurring would increase “by a factor of 1.2-1.4” compared to 2021 (Kreienkamp et al. 2021, 1).

Therefore, it can be confidently stated that the events which befell the Ahr Valley and its population in 2021 were directly aggravated by the effects of climate change. It was also in the aftermath of the flood that Ahrweiler County saw a drop in population numbers while the population in all of its neighboring counties increased (figure 4). Precisely, using the German Federal Statistical Office’s GENESIS dataset, which was last updated in 2021, it can be determined that Ahrweiler County’s population dropped by 2,333 residents between 2020 and 2021 (Destatis 2023).

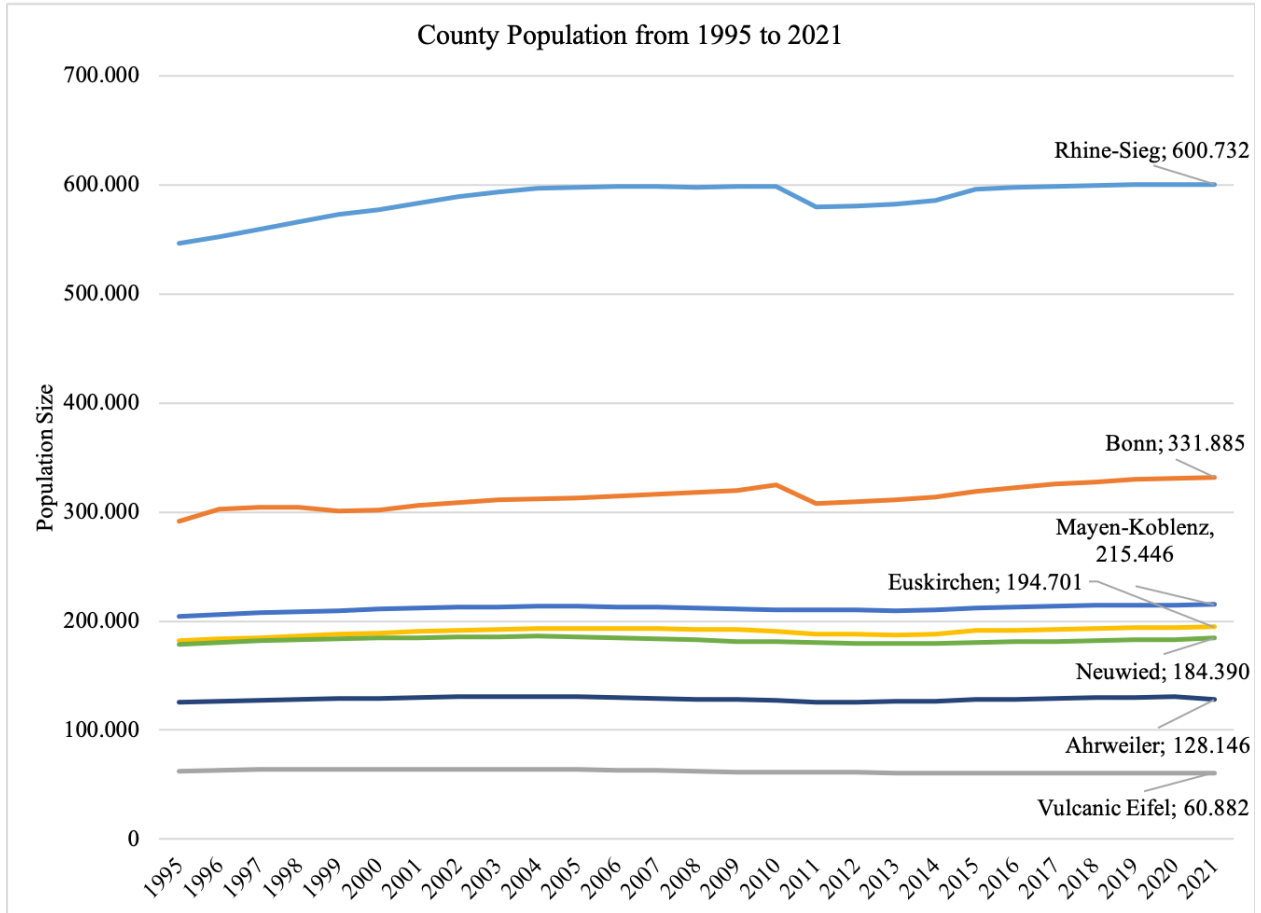


Figure 4. Graph showing the population numbers of Ahrweiler County and surrounding counties between 1995 and 2021. Graph by author. [Note: The values indicated follow the German numbering system by which dots are used as thousands separators instead of commas. Therefore, 128.146 is to be read as 128,146.].

While this drop in Ahrweiler County’s population is significant in its own right, a study conducted by German national broadcaster ZDF in 2022 determined that 10% of the Ahr Valley’s population had moved out of the valley within one year of the flash flood (Büngen 2022). Taking both these statistics into consideration, it can be determined that immediately after the flood, a mass exodus took place away from the Ahr Valley to other, presumably higher elevated locations in Ahrweiler County.

Here to Stay or Move Away?

Per the ZDF study, post-traumatic stress disorder was named as a factor that went into a decision to leave the Ahr Valley for good (Büngen 2022). This psychological impact the flood had on its victims is echoed by the persons interviewed as part of the field research conducted for this study.

Oliver, a 55-year-old recent retiree from Insul and native of the Ahr Valley, is one of them. The interview with him took place in a café in Adenau, a town in the hills above the Ahr Valley, where he moved to in the aftermath of the flood.

Oliver had spent the afternoon and evening hours of July 14, 2021, clearing his property's garden of goods he feared might be damaged by heavy rain and the rising river waters. In the meantime, his girlfriend and neighbors decided to bring food and their pets to a higher location in his house. The property was located on a slope several meters from the riverbed.

“We didn't know what 200ml/m² of rain meant when it was mentioned in the weather report, so when the rain continued falling, we didn't think much of it and simply decided it would be best to move the flower pots to higher ground. (...) Once I was in the house, I was told that groundwater was coming up through the drain in the basement, so I went to check on it. I was downstairs trying to fix the issue when the water came crashing through the basement door. I remember the doors of the basement rooms breaking one by one.” (Oliver knocks on a table to imitate the sound of the doors breaking). “I managed to rush up to the ground floor, but once I got there, the [house's] outer wall gave way, and water came crashing through.”

The flash flood tore through the house, broke the windows of the ground-floor living room and swept Oliver outside. In a lucky break, the wave crashed him into an island that had formed in the torrent. “When I came to, I realized the house was gone,” he recounts. Oliver would spend 15 hours stranded on the island, pictured in figure 5, as the flood waters continued to rise around him.

“I saw bodies, oil tanks, and gas tanks float by. I thought everyone in the house was dead. I had a gashing wound on my foot, and as the water continued rising around me, I just said to myself ‘if you know you won’t make it [out alive], jump into the flood.’ (...) At some point, I heard the sound of helicopters, but they never came to rescue anybody that night, so I did first-aid on myself, sat down, and waited.”



Figure 5. Oliver (pictured left of the tree) stranded on an island in the floodwaters the morning of July 15, 2021, after the main flash flood had passed. Photograph directly provided to author by Oliver Grieb.

Oliver describes himself as “lucky.” At noon on July 15, he was airlifted to safety and made a full recovery after spending two weeks in the hospital. When asked the question whether he would move back to the Ahr Valley he responded no. His brush with death left him traumatized, he says, “If it starts raining in Adenau, I put on my headphones and tune it out.”

Evidently, a well-founded fear of such an event recurring has hindered him from returning to his native valley. He believes he may have stretched his luck in July 2021 and recounts that others were not as lucky, “A friend of mine heard his family die in the flood.” Finally, he mentions that he would also not return to Insul due to financial reasons and the bureaucracy linked to receiving any kind of government financial aid.

“[To apply for government rebuilding aid] you need to fill out a 56-page e-form. If you make a mistake on, say, page 34, you can’t go back and fix it. Even if I wanted to put up with this form, my house could not be rebuilt anyway, and I would not be properly compensated for my financial loss because the land on which it was built has been re-classified from residential usage to a lawn. At the time of the flood, my property of 1096m² was valued at 41 euros per square meter. If I were to apply for compensation, now that it has been re-classified, the government would refund me 0.60 euros per square meter.”

For Oliver, the bureaucratic mechanisms in place to apply for government aid, which reimburses those affected up to 80 percent of flood-induced damage to their property, are a further sign of a disconnect between rich politicians and the general population, which he sees embodied in Armin Laschet. The longtime frontrunner candidate for the German chancellorship in the 2021 federal election could be seen cracking jokes while the President of Germany delivered a speech on the flood in the disaster-struck area.

Just under two years later, Oliver is content with his apartment in Adenau, and he says he is not the only one who moved uphill. Many of Insul’s residents decided to move to higher

ground in the aftermath of the flood. Yet, experiencing and surviving a life-threatening situation does not necessitate moving away for some.

Unbeknownst at the time of the following interview, the person interviewed would turn out to be Oliver's girlfriend, Manuela. This interview had taken place a day prior to the meeting with Oliver during canvassing in Insul. Manuela's story is also one of luck as she was in the same house as Oliver at the time he was washed away; a similar fate would strike the entire house minutes later.

"We [Manuela and her neighbors] were in the attic when the house was torn away. The attic then rotated 180 degrees and turned into a raft with all of us in it. We then crashed into the neighbor's house, and I managed to find a plank to get us off the attic and onto the other house. I didn't even get wet."

Similar to Oliver, Manuela, age 50, has carried a psychological burden since that night. Yet, her approach is to face it directly. "I will go to the river, close my eyes and see the flood before me. (...) It will always be there with me. You can't just forget something like that," she says. The neighbor's son, who had been in the attic with her, has been severely traumatized and is in psychological care, she claims. Still, just as she has decided to remain in the Ahr Valley, so have her neighbors, and in contrast to Oliver, it was government financial aid as well as a deep connection to her hometown that made her stay. Through the government aid program, she has been able to build a house on a plot of land that had already been designated for residential development in Insul, she explains. As soon as construction is finished and the house is ready for occupation, she will move in together with her mother. While Manuela has moved to a town

beyond the valley, this is a temporary decision that was made out of necessity, she says. She wants to return to her *Heimat*, her home, as soon as possible.

This connection to home and the desire to stay is echoed in interviews across the valley, as was the case in an interview with a vintner in Altenahr. Her wine shop is the only store open on her street. Likewise, the house in which the store is based is the only inhabited and renovated one on said street, standing out from neighboring properties that still visibly carry the scars of the flood almost two years later. The shop she runs is part of a larger family-owned wine wholesale business typical of the mid-sized, often family-owned, German *Mittelstand* companies that make up the backbone of Germany's economy. A couple of houses further down the street, the company's wine cellar is almost completely rebuilt after it was destroyed by the floodwaters. "This is home," she says.

"We [the family] have a business here that we can't just give up, so we applied for government aid and started rebuilding as soon as possible. We also used our personal funds to expedite the effort and were able to re-open the business in August 2022."

When asked whether she would have left Altenahr if she did not have a business and family that tied her down, her simple response was "No. This is home."

The wish to keep the family business running is also what motivated 54-year-old Wolfgang Ewerts to renovate his flood-ravaged hotel on the banks of the Ahr River back in Insul. While he partially financed the reconstruction effort using government aid, he also took out a loan to pay for incurred expenses as he saw the flood as an opportunity to build back better and improve the facilities the hotel previously had.

“After the flood, my son pulled me aside one day and told me, ‘Dad, I want to continue your work and take over the hotel business,’ so I immediately started the rebuilding process (...) I did it for my son, and he was the primary factor that cemented my decision to rebuild the business in its original size and scale here, in the same place.”

Wolfgang was also one of the few people who had taken out storm and tempest insurance before the flash flood hit. This, in combination with the government aid and bank loans, effectively meant that his bank account barely took a hit from the flood. In fact, just as in the case of the wine wholesale business, Wolfgang was able to re-open his hotel in August of 2022, and business is booming. “We are fully booked for the upcoming season.” “I don’t worry about floods,” he continues. Perhaps, it is the fact that he had been away on vacation on July 14, 2021, that contributed to this mindset.

Per Insul’s 75-year-old mayor, Ewald Neiß, Wolfgang Ewert’s decision to stay in town and continue operating his business is no exception.

“Out of the 23 businesses we had in town prior to the flood, not a single one decided to leave, and neither did most of our residents. Tourism is back in town and we are rebuilding in accordance with new government mandates to improve flood security.”

On a walking tour of Insul, he points toward houses being built with floodable basements. “The [Rhineland-Palatinate] Secretary of State has designated new areas to construct residential buildings, and pretty much everyone is fine with that. Those who aren’t, aren’t natives anyway - a real estate agent who moved here from outside the valley sold his house and left after the government mandated he renovate his basement according to the

new standards, but he's an exception. Unlike the people in Bad Neuenahr, we aren't moving away! There's more anonymity there [in Bad Neuenahr-Ahrweiler], so people decided to pack up and leave for Bad Ems or another spa town, but not here. We're close-knit."

"The human being quickly forgets," Ewald Neiß repeats multiple times throughout the interview in reference to the devastation the flood caused. "That's why so many people have decided to stay." Still, he offers a word of caution. "If another flood hits, the Ahr Valley will go empty. The people will leave because there will be insufficient financial resources [to rebuild]."

Missy, an entrepreneur and artist in her late thirties from the highlands surrounding the Ahr Valley who founded an organization consisting of volunteers who aid in rebuilding and organizing cultural events in the valley, calls the Ahr Valley's mayors "the heroes of the flood disaster." According to her, they were the first to take the initiative and start rebuilding while other politicians were still processing the flood. Personally, she sees the flood as a double-edged sword that, on the one hand, caused widespread devastation and grief but on the other, can be used as an opportunity to rebuild the valley in a more sustainable and inclusive way.

"We are in a rich region where people have enough money to rebuild without any government aid. In fact, many people are doing exactly that, so let's make the best of it. I'm convinced that business in the valley will flourish soon."

Missy believes her organization and a general sense of solidarity amongst the valley's residents have created a positive outlook for the future that factors into people's decisions to stay. She uses two of her employees, one of whom is a Syrian refugee, to prove her point. Per

Missy, owing to the rapid provision of tiny houses after their residences were destroyed, her employees were able to remain in the valley and decided against moving elsewhere. While such acts of solidarity seem to influence decisions to stay, the role climate change denialism plays in decision-making is also noteworthy. According to her, climate change denialism paired with what she terms “flood dementia,” a willful decision to ignore the destruction caused by the flood, creates a reluctance to even think about moving away due to natural disasters amongst the valley’s residents. These circumstances have contributed to a minimization of the social and economic damage suffered.

Additionally, local solidarity has been supplemented by help from other regions of Germany and Europe as skilled workers stream into the valley to assist in the rebuilding process. In fact, the German government has used the region’s call for outside help and a nationwide skilled labor shortage to open a new immigration pathway to Germany, a lawyer from the region’s chamber of trade explains. Under this new scheme, skilled laborers from abroad, regardless of their qualifications, are allowed to permanently settle in the Ahr Valley, provided they work for a local company. Accordingly, these developments have given the local economy an essential boost.

While solidarity was strong amongst the valley’s residents, all of the persons interviewed felt abandoned by county or state government officials at least once between July 14, 2021, and the time of writing. For Erika, the owner of a vacation home in Bad Neuenahr-Ahrweiler, which was severely damaged by the flood, the county government’s decision to hold off declaring a state of emergency was one such occasion. Although she doubts an earlier state of emergency declaration would have saved her property from damage, she believes human lives could have been saved. Nevertheless, politics did not affect her and her husband’s decision to stay and

rebuild the house which has been in their family's ownership for two generations. Instead, they were incentivized to stay by the large social network they had established in Bad Neuenahr-Ahrweiler, with many friends and family members living close by. Despite the long processing time of their government aid petition, they received funding relatively quickly once the petition was approved, alleviating the financial burden of renovating the house. Still, rising inflation rates in 2022 and 2023 meant that Erika and her husband, who are both in their early sixties, had to pour a substantial amount of their own money into the rebuilding effort. Their decision to keep the property was not reflective of the norm in their neighborhood. "Many of our neighbors died, and many others decided to sell their houses and leave after the flood," Erika recounts. According to her, this led to a demographic shift as these houses were bought by young people who had established careers in Bad Neuenahr-Ahrweiler and surrounding areas, leading them to stay. Erika also sees a link between property ownership and the decision to stay or leave. Even though many property owners decided to sell their houses in her neighborhood, she claims that it was mostly people who rented apartments that left the city and the valley for good after the flood. Likewise, many of her close relatives have decided to permanently move to higher elevations either in or close to the valley, while others whose houses were destroyed by the flood have temporarily moved to other municipalities in the state of Rhineland-Palatinate with the goal of returning to the Ahr Valley in the near future. Reflective of the many narratives heard along the way, the idea of turning their backs on their home, where they have established livelihoods and extensive social networks, is out of the question. For them, the Ahr Valley is and will remain their *Heimat*.

Discussion

It appears as though the interviewees' vastly different lived experiences the night of the flood may have contributed to their decision to leave or stay in the valley. Oliver, who was washed away and barely made it out of the Ahr Valley alive, clearly stated no desire to ever move back to the valley. It is undeniable that physically experiencing the flood and its full force impacted his migration decision, putting him in contrast to Wolfgang who did not experience the flood physically and has a carefree attitude toward flooding. The bodily and psychological harm as well as the financial damage the flood inflicted upon Oliver on top of what he considers an inadequate fiscal response by the government have decreased his sense of security in the valley to the point of no return. Instead, he has relocated to a higher elevation in immediate proximity to the valley; Adenau is a 10-minute uphill drive away from his former home in Insul. Together with Erika's observation that a large number of her relatives moved to higher elevated municipalities close to the valley, this indicates that many of those who decided to leave their old places of residence in the valley did not abandon the larger area of residence, i.e., Ahrweiler County. Moreover, it provides an explanation why the Ahr Valley's population substantially decreased compared to that of Ahrweiler County and supports the fundamental *Laws of Migration*, which laid the groundwork for scholarly migration theory (Ravenstein 1889, 286).

Erika's and her husband's decision to rebuild their vacation home despite several neighbors losing their lives in the flood stands in stark contrast to Oliver's decision to leave, but so too does the fact that Erika was not in the Ahr Valley when the flood struck, meaning she did not face the life-threatening situation. Concurrently, she stated that she and her husband did not want to abandon their previously established network of friends and family, signifying the role social networks play in migration decision-making, a notion supported by existing academic

findings which indicate that living in proximity to family “increases the likelihood of staying,” while “decreasing the propensity to migrate” (Thomassen 2020, 3). Related to this, many of the interviews elucidate how a decreased sense of anonymity and a strong sense of solidarity might have increased the likelihood for persons affected by the flood to remain in the Ahr Valley.

Meanwhile, business owners seem to have a further reason to remain immobile and rebuild, as many of their livelihoods depend on their companies, which are established and appreciated components of their local communities. For *Mittelstand* businesses, the fact that they are family-owned and operated also ties into the decision to remain, as was captured in the desire of Wolfgang’s son to rebuild the family hotel as well as the vintner’s statement that her family cannot abandon their established business. Ultimately, all interviewees elaborated on the positive contribution deep-rooted social and business networks appear to have made to the decision to either stay in or close to the valley after the flood disaster. Under consideration of the age of those interviewed for this study, these results are largely coherent with previous academic research, which found that out-migration in climate change-affected areas decreases with age if affected individuals have well-established kinships in said areas (Entswile et al. 2020, 1493). As the sample used in this study does not include anyone in their twenties, it is hard to assess whether younger Ahr Valley residents may have higher rates of out-migration and whether the flood disaster had an impact on their decision to move away.

It is also worth noting that international migration to the Ahr Valley was observed as the demand for laborers opened pathways for immigrants to settle and work there. This unique occurrence finds little to no mention in existing literature on climate migration and is seldom brought to public attention in similar climate change-induced disaster situations.

The interviews also demonstrated the influence German government efforts have had on migration decision-making in the aftermath of the flood. These efforts most clearly manifested in two different ways. Firstly, through a 30-billion-euro government fund created in part to compensate people who suffered damage to their property or business. The regular compensation amounted to up to 80 percent of damage costs, though if affected persons successfully proved extraordinary hardship, they would receive full compensation for the damages they incurred. If persons were rendered homeless by the flood and had a salary below a certain threshold, they were able to make use of government rent subsidies (Presse- und Informationsamt der Bundesregierung 2022). Still, there were certain conditions that had to be fulfilled in order to receive government aid. Private individuals who wanted damage compensation had to assure the government that the money would be used toward the renovation of their flood-damaged property if the government deemed the property's location safe for reconstruction. Otherwise, they would have to rebuild their property within the same municipality. Businesses were given more leeway, as they were provided government aid as long as they continued operating from anywhere within the state of Rhineland-Palatinate, meaning they were able to leave the Ahr Valley and still be compensated. Nevertheless, the overwhelming majority of businesses decided to stay in the valley. The government fund was also used to rebuild destroyed infrastructure, with the German government assuring its populace that the financial burden for infrastructure redevelopment would not be carried by taxpayers. Finally, financial assistance was provided by the European Union by way of the European Union Solidarity Fund (EUSF). Money from the EUSF was further used toward infrastructure projects, but also cleaning-up operations and the redevelopment of cultural institutions lost in the flood (Presse- und Informationsamt der Bundesregierung 2022). All flood-affected interviewees mentioned that they had received at least

some kind of government aid, although not all of it was for rebuilding damaged or destroyed property, as was the case with Oliver. He received the rent subsidies that covered initial housing costs after he was discharged from the hospital. For some individuals like Manuela, receiving government aid was a crucial factor in the decision to stay and rebuild. In Manuela's case, the government's financial aid scheme achieved what it was intended for: helping people in the region rebuild quickly for the long term (Presse- und Informationsamt der Bundesregierung 2022).

The second way government aid manifested was through the implementation of new government guidelines, which re-designated the land usage of areas in the Ahr Valley that are especially vulnerable to flash floods, a development that Oliver mentioned when he elaborated on government bureaucracy. Per these guidelines, all plots of land in direct proximity to the Ahr River, irrespective of whether they were developed for residential living, were classified unfit for habitation, as can be seen in figure 6. These new guidelines were also referenced by Ewald Neiß when he mentioned that one resident of Insul moved away after the flood due to new government mandates regarding basements. As part of the land re-designation, the building code was amended to require all buildings within a certain proximity of the Ahr River to have floodable basements (figure 6). Arguably, the goal of this re-designation was not to make people leave the Ahr Valley altogether but rather to minimize damage and exposure to danger in the case of another flash flood by enforcing building permit restrictions. Still, some interviews clearly referenced these new guidelines as contributive to the decision to leave the Ahr Valley. Ultimately, however, the overall availability of resources and the adaptive solutions to tackle the damage caused by the flood seems to have provided great incentives to remain in the Ahr Valley, echoing findings by previous scholars (Entswile et al. 2020, 1471).

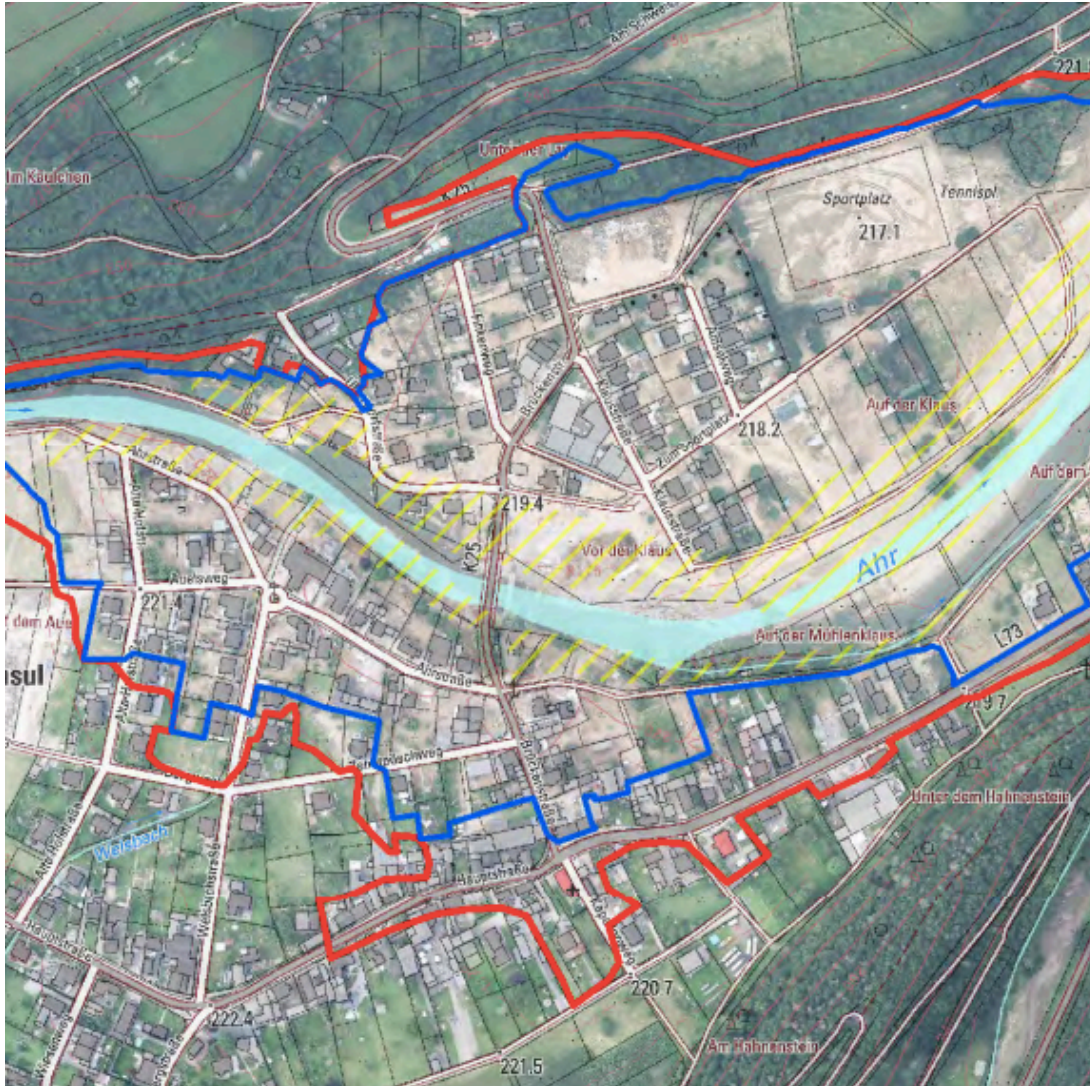


Figure 6. Map showing areas in Insul that were re-designated after the 2021 flood and visualizing the Ahr River contained within its riverbed. These re-designations took place throughout the valley. The yellow-dashed area was previously suitable for residential development and has been re-classified as uninhabitable. The land within the blue area has been re-designated as the Ahr River's flood zone; it is in this area that all buildings must be renovated according to new government guidelines stipulating floodable basements. Finally, all areas within the red zone were affected by the 2021 flash flood. No new guidelines were implemented for buildings outside of the yellow-dashed and blue zones. Map by Land Rheinland-Pfalz (2021, 26).

Conclusion

Despite its novelty in academic terms, the field of climate migration and displacement is highly diversified, placing literature that demands specific action on pinpoint climate disasters at its forefront. This paper seeks to break from this tendency by providing insights into lessons learned from an already transpired climate disaster which will be summarized in this closing chapter. Using the never-before analyzed Ahr Valley flood disaster to research the migration and immobility ensuing in its aftermath, the in-depth insights gained through this study offer unique and novel perspectives that can help shape the future study of climate change and human mobility. As part of the research process, interviews were conducted while the realities on the ground were thoroughly examined.

Through the garnered results, it can be deduced that the way the effects of climate change-related natural disasters influence the decision to migrate away from disaster-struck areas varies depending on the individual, their circumstances, and the resources available to them. Perhaps the most valuable takeaway from this paper, one that is reiterated in academic literature on human mobility, is that under certain circumstances, people are prone to remain in the place they call home, even in the face of mounting adversity. The threshold for migration certainly differs between individuals, yet even in the Global North, where government aid mechanisms are in place and governments have financial resources to immediately react to climate change-induced natural disasters, climate migration cannot be prevented and will continue to occur in the future. Nevertheless, what this study's interviews overwhelmingly support is that even if the threshold is crossed in the aftermath of a climate disaster, migrants are likely to remain close to their former home. This should be a point of consideration when developing solutions to tackle future climate migration.

The establishment of social and business networks as well as government assistance seem to play a crucial role in deterring long-distance mass migration as they make affected individuals feel sufficiently supported to deal with the adversity brought about by climate change. Sufficient capacity to adapt to or mitigate the adverse effects of climate change is also a cogent contributor to the decision to willingly remain immobile after a climate disaster. Therefore, international aid for countries that cannot afford mitigation or adaptation or extensive assistance programs for their populations might go a long way in ensuring that those who want to stay and rebuild after a rapid-onset climate disaster are able to do so. Solutions should not be limited to the macro-level, however. Community organizing, as was done in the Ahr Valley, can help foster a sense of solidarity that roots persons in their place of abode and possibly raises the migration threshold.

Throughout the Ahr Valley disaster's timeline, government bureaucracy appears to have had negative effects ranging from the lack of authority given to the DWD and municipal leaders to warn the population, which likely resulted in increased casualties, to several dozen-page-long government aid applications whose sections cannot be amended once filled in. In certain cases, this contributed to an estrangement between the government and the general population so intense that it strengthened the decision to leave and settle outside the valley. A valuable lesson learned from this is that there need to be mechanisms in place allowing for well-founded expert opinion, that carries the highest merit in certain emergency situations, to be forwarded to the public independent of government approval. Related investments should be made in emergency notification systems that ensure the correct warnings reach as many imperiled people as possible in an emergency. Still, a middle-ground should be found regarding experts' independence from the government as it harbors the potential complication of increasing alarmism. Additionally, public threat perception varies between countries and regions, a fact those who raise the alarm on

potential dangers need to be cognizant of. Regarding aid provision, governments or actors providing aid must be conscious of the circumstances people affected by natural disasters are enduring. It may be too much of an expectation for these persons to complete government forms exceeding 50 pages, where errors are irreversible, without any assistance. Essentially, providing expert assistance to help fill out the forms and reducing the forms' length would greatly benefit getting those affected by natural disasters the financial resources they require.

A further point of consideration is that migration in large parts of the Global North is facilitated by the sheer size of countries like the United States, Australia, and Canada, meaning there is less of a need for cross-border climate migration, as well as the European Union's Schengen Area where the countries may be smaller but freedom of movement is ensured. Future research could look at the impacts of these realities on climate migration and whether they are more likely to produce more migration flows in the Global North.

It should be kept in mind that the case analyzed in this paper is a rapid-onset climate event that dissipated as quickly as it appeared. Therefore, the insights gained through the study of the Ahr Valley only find limited application to slow-onset and irreversible climate change-induced disasters like the inundation of islands in the South Pacific. Future research on whether proclivities, like a migrant's preference to remain close to their place of departure, also apply to slow-onset cases will be invaluable to determine climate migrants' preferences in relocation or resettlement should their home countries be unable to sufficiently mitigate or adapt to the effects of climate change.

Ultimately, and as illustrated by this paper, research on climate change and human mobility in the Global North is relevant to understanding the dynamism and factors at play when discussing climate migration, and future research focusing on the Global North is highly

encouraged. After all, as climate change intensifies, so too does the number of analyzable cases increase, with human mobility following New Zealand's 2023 Cyclone Gabrielle providing one of the most recent avenues for exploration.

Appendix A: Interview Questions (Personal Narratives) – Ahr Valley Study

1: Introduction - Tell me about yourself.

2: How long have you been/were you a resident of the Ahr Valley?

3: Where were you on the eve/the night of the Ahr Valley flood, and how did you experience it?

4: Were your loved ones affected by the flood?

5: Did your property or place of abode suffer damages from the flood?

6: [IF RESPONDENT DECIDED TO STAY] Are there any particular reasons that compelled you to stay? Did you have to rebuild? Were you provided community assistance or government aid?

7: [IF RESPONDENT DECIDED TO STAY] Do you worry such an event might reoccur?

8: [IF RESPONDENT DECIDED TO LEAVE] What compelled you to leave? Would you consider returning to the Ahr Valley?

9: Do you know of any other people who decided to stay or leave? [If people who left are mentioned] Do you know where they moved to? Would you be able to provide me with their contact information?

10: [Open-ended final question] Is there anything else you would like to tell me regarding the flood (and its aftermath)?

Appendix B: Interview Questions (Expert Interviews) – Ahr Valley Study

1: Introduction - Tell me about yourself.

2: How long have you been dealing with the Ahr Valley in your work?

3: Did your work change in the aftermath of the Ahr Valley flood? Was your work or the company/organization you work for directly affected?

4: Did you work on an issue directly related to the Ahr Valley flood? Did you directly contribute to the rebuilding efforts in the Ahr Valley?

5: Do you have data you could share with me? [IF PROVIDED WITH DATA, I WILL ASK THE EXPERT TO ELABORATE ON THE DATA WITHIN THEIR FIELD OF PROFESSION].

6: Do you believe [LEGAL/ECONOMIC/POLICY] decisions made before and in the aftermath of the flood impacted the Ahr Valley population, and in which ways?

7: Do you know of any other people who decided to stay or leave? [If people who left are mentioned] Do you know where they moved to? Would you be able to provide me with their contact information?

8: Do you know any experts who can provide me with further information? [If further experts are mentioned] Would you be able to provide me with their contact information?

8: [Open-ended final question] Is there anything else you would like to tell me regarding the flood (and its aftermath)?

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