

Insurability and Mitigation of Flood Losses in Private Households in Germany

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In Germany, flood insurance is provided by private insurers as a supplement to building or contents insurance. This article presents the results of a survey of insurance companies with regard to eligibility conditions for flood insurance changes after August 2002, when a severe flood caused 1.8 billion euro of insured losses in the Elbe and the Danube catchment areas, and the general role of insurance in flood risk management in Germany. Besides insurance coverage, governmental funding and public donations played an important role in loss compensation after the August 2002 flood. Therefore, this article also analyzes flood loss compensation, risk awareness, and mitigation in insured and uninsured private households. Insured households received loss compensation earlier. They also showed slightly better risk awareness and mitigation strategies. Appropriate incentives should be combined with flood insurance in order to strengthen future private flood loss mitigation. However, there is some evidence that the surveyed insurance companies do little to encourage precautionary measures. To overcome this problem, flood hazards and mitigation strategies should be better communicated to both insurance companies and property owners.

KEY WORDS: Damage compensation; Elbe flood; insurance; natural hazards; precautionary measures

1. INTRODUCTION

A severe flood event struck Germany, Austria, the Czech Republic, and Slovakia in August 2002 in the catchment areas of the Elbe and the Danube. In Germany, 21 people were killed and substantial parts of the infrastructure were destroyed. The most affected German state was Saxony, where the total flood damage estimate had risen to 8.7 billion euro by December 2003 (Sächsische Staatskanzlei, 2004). Saxony was followed by Saxony-Anhalt with 1.2 billion euro in damages (IKSE, 2004). Meanwhile, to-

tal losses in Germany were estimated to have been 11.6 billion euro, of which 1.8 billion euro were covered by insurance. The figure of 15% insured loss is rather low in comparison to other flood events in Germany (see Kron, 2004). This may be due to the enormous damage to infrastructure. Only 45% of the losses were sustained in the private sector (Kron, 2004).

The economic losses from August 2002 exceed losses caused by other natural disasters in Germany by far. Therefore, many administrative and legislative projects were launched to improve flood risk management (see DKKV, 2003). Immediately after the flood, the German government launched an emergency relief fund of 500 million euro and a reconstruction aid fund of 7.1 billion euro (*Sonderfond Aufbauhilfe*). Furthermore, money from the European Union Solidarity Fund (444 million euro), public donations (350 million euro), and insurance

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compensation (1.8 billion euro) were available for loss compensation (Mechler & Weichselgartner, 2003; Schwarze & Wagner, 2004; DZI, 2004). In comparison to natural disasters in other industrialized countries, such as the Kobe earthquake in 1995, as well as to other flood events in Germany, governmental assistance, amounting to more than 60% of all losses, is very high for the August 2002 flood (Mechler & Weichselgartner, 2003). An analysis of seven earthquakes and floods that occurred in the 1990s revealed that on average only 45% of total disaster losses were compensated by governmental aid and insurance together (Linneroth-Bayer *et al.*, 2001). For example, during the severe flood in the catchment area of the Rhine River in 1993 (total losses of 530 million euro, of which 160 million euro were insured losses), only 10% of the losses were compensated by governmental assistance and about 60% of the losses remain uncompensated (Linneroth-Bayer *et al.*, 2001).

Governmental disaster assistance is often criticized as an ineffective and insecure way of dealing with flood losses (Anderson, 2000; von Ungern-Sternberg, 2003; Schwarze & Wagner, 2004). Since government aid (in Germany) is not based on formal legislation, it depends, for example, on the extent of the disaster or the media coverage. Thus, affected persons cannot rely on this kind of compensation. Insurance coverage, however, provides a right of compensation agreed upon by contract (e.g., compensation for building damage, clean-up costs) and loss compensation is reliable and fast (Platt, 1999; Kron, 2004; FEMA, 2004). Moreover, governmental disaster assistance is commonly financed by (additional) taxes and can thus weaken overall economic development due to a reduction in purchasing power and the government's limited ability to invest (von Ungern-Sternberg, 2003).

Flood insurance is available in several countries, including Germany, but conditions and concepts are very different. Various systems have been compared, e.g., by Swiss Re (1998), Barraque (2000), Graff (2001), Vettters and Prettenthaler (2003), and von Ungern-Sternberg (2004).

The most difficult problem is anti-selection: insurance coverage is mostly requested by people in flood-prone areas who are frequently affected by floods, whereas people in low or residual risk areas are not interested in flood insurance coverage. Thus, the basic principle of pooling of risks is violated. This problem is tackled by different approaches ranging from nonprovision of insurance coverage (e.g., in the

Netherlands), governmental disaster loss funds with a fixed pay-out amount per year (e.g., in Finland), (restrictive) private insurance (e.g., in Germany or the United Kingdom), private insurance in combination with a state reinsurance (e.g., in France), to compulsory building insurance for all building owners (e.g., in most cantons of Switzerland and in Spain) (Swiss Re, 1998; Barraque, 2000; Vettters & Prettenthaler, 2003). In the latter case, insurance coverage is provided by (state) monopoly insurance institutions, which have the advantage of low advertising and administration costs in comparison with the competitive private insurance companies (von Ungern-Sternberg, 2004). In addition, such an insurance system can be better combined with land-use planning and flood loss mitigation. Swiss building insurers, for example, spend a considerable amount of the premiums, about 15%, on mitigation (von Ungern-Sternberg, 2004). However, private insurance companies also publish guidelines on flood loss reduction (e.g., ABI, 2004).

The combination of flood insurance with land-use planning and damage mitigation was also an important concept in the U.S. National Flood Insurance Program (NFIP), which is—in contrast to the Swiss and Spanish systems—a voluntary insurance for most building owners and partly subsidized by the state. The NFIP is well documented and its success and reforms have been critically analyzed (e.g., Richman, 1993; Platt, 1999; Anderson, 2000; Burby, 2001; Chivers & Flores, 2002; FEMA, 2002).

The NFIP was launched in the United States in 1968. In its framework, flood-hazard zones and the degree of flood risk were identified, criteria for construction in floodplains were established, and risk-based flood insurance premium rates were set (Burby, 2001). The flood insurance rate maps, showing all the areas that would be inundated by a 100-year flood, are not merely guidelines; the mapped flood-prone areas and the flood elevation data are legally binding (Platt, 1999). The maps are relevant for flood insurance premiums as well as for damage mitigation, since the NFIP focuses on flood loss prevention up to the 100-year flood level. Thus, the lowest floor (including the basement) of new constructions has to be elevated to the level of the 100-year flood.

At the beginning of the NFIP, it was assumed that additional costs for flood insurance premiums and for fulfilling hazard mitigation requirements would make settlements in floodplains uneconomic (U.S. Congress, 1966b in Burby, 2001). However, 30 years

of rising flood losses have led to the conclusion that the NFIP could not stem the tide of extensive development in high-risk areas (Burby, 2001). Some authors even suggest that flood insurance has allowed, if not encouraged, development in floodplains (see Arnell, 1987; Richman, 1993; Platt, 1999). On the other hand, the NFIP has contributed to considerably reduced susceptibility of new structures to flood impacts: buildings erected before 1975 have suffered approximately six times more flood damage than buildings that meet the NFIP mitigation requirements (Pasterick, 1998 in Burby, 2001).

White and Etkin (1997) concluded that a proactive campaign to strengthen the demand for mitigation measures would be an essential next step in attenuating the increase in disaster losses attributable to societal changes such as increasing population density, growing economies (more consumption and accumulation of goods), urbanization, and concentration of people in high-risk coastal areas, as well as to climate change. In theory, public agencies, insurers as well as property owners, contractors, and developers should be interested in mitigation measures, particularly in cost-effective measures. These are measures for which the discounted expected benefits over the life of the property are greater than the upfront investment expenses and other costs (Kleindorfer & Kunreuther, 1999). However, few property owners voluntarily adopt mitigation measures. Investigations in the United States revealed that less than 15% of building owners have taken action to flood-proof or retrofit their building (see Burby, 2001 for further references; Blanchard-Boehm *et al.*, 2001). It may be that people do not believe that investments in (long-term) risk reduction measures will increase their residence's property value, or they may have short time horizons and/or severe budget constraints (Kleindorfer & Kunreuther, 1999). However, several surveys among flood-affected private households in Britain have shown that there is no evidence that flood insurance discourages emergency actions (Arnell, 1987).

Some authors discuss concrete actions that insurers and governments might undertake to encourage mitigation measures. Kleindorfer and Kunreuther (1999) demonstrated that both insurers and property owners could benefit from mitigation even if it was to be rewarded by lower deductibles. However, if insurance was to serve as an effective tool for reducing future losses due to natural disasters it needed to be linked to well-enforced building codes (Kunreuther, 1996, 2001; Kleindorfer & Kunreuther, 1999). Build-

ing codes mandate that property owners adopt mitigation measures. To encourage their adoption, Kleindorfer and Kunreuther (1999) suggested a certificate of disaster resistance for each structure that meets or exceeds building code standards. Such a certificate would enable financial institutions, contractors, and insurers to offer various incentives, e.g., low-interest loans, reduced deductibles, premiums, or taxes (Kleindorfer & Kunreuther, 1999; Kunreuther, 2001). Insurers may also want to limit coverage only to those structures that are given a certificate of disaster resistance (Kunreuther, 2001).

Germany is one of the few European countries in which private insurance companies have offered natural hazards insurance as a supplement to contents or building insurance (Vetters & Prettenhaler, 2003). So far, little is known about the terms of insurance in Germany, how insurance companies reward mitigation strategies of residents, or how they are involved in flood risk management as a whole. Moreover, it is unclear how flood insurance coverage influences risk awareness and loss mitigation strategies in private households. Therefore, this article addresses the following research questions:

- What are the terms for natural hazards insurance in Germany? What changes occurred after the August 2002 flood?
- How many people had insurance coverage during the August 2002 flood and how did this affect their loss compensation in comparison to uninsured households?
- How does insurance coverage influence flood risk awareness and loss mitigation in private households?
- How do insurance companies support flood risk reduction and mitigation and how are they involved in overall flood risk management?

2. DATA AND METHODOLOGY

Two surveys were undertaken to answer the above-mentioned questions. A standardized questionnaire was mailed to 119 insurance companies. The questionnaire comprised 30 questions, utilizing mainly checklists providing the opportunity for open-ended answers. The following topics were addressed:

- characteristics of the insurance company: insurance products relevant to losses due to natural disasters, year of launch, types of perils covered, percentage contribution of natural hazards insurance premiums to total turnover of the company;

- flood risk analysis: flood hazard assessment of households applying for insurance; general and special conditions that have to be fulfilled to obtain insurance coverage (distinguishing between insurance on building and contents; as well as the situation before and after the 2002 flood); information given to the insured about the hazard zone they are living in; general information given to the insured or brochures regarding flood loss mitigation; existence, type, and range of deductibles; kinds of loss mitigation measures that are rewarded by the insurer; types of rewards; amount, and return interval of loss accumulation of the company;
- losses due to the August 2002 flood: percentage of the insured who were affected by the flood, status of surveying losses, completion date of loss compensation, mitigation measures that effectively reduced damage, kind of losses frequently claimed; total and average loss compensation;
- consequences of the flood event in 2002: kinds of changes in insurance conditions (distinguishing between existing and new insurance contracts); change in demand and number of contract conclusions after August 2002;
- the role of insurers in flood risk management: general involvement of the insurance industry in different fields of flood risk management (assessment on a rank scale from 1 = insurance should play a decisive role to 6 = insurance should not participate); general issues where insurance companies require more influence; attitude toward compulsory natural hazards insurance.

The response rate to the questionnaire was 21% (i.e., 25 of 119 insurance companies). Sixty percent of the insurance companies who returned the questionnaire (15 of 25 companies) had been affected by the 2002 flood. Twenty companies (17%) gave written or verbal notice that they would not participate in the survey. The main reasons for nonparticipation were that the survey was considered to be outside the scope of insurers or that the Association of German Insurers (GDV) was regarded to be responsible (12 cases). Therefore, an interview with a representative from the GDV was carried out based on the questionnaire (referred to as GDV, pers. comm., 2003). Other reasons for nonparticipation were lack of available manpower to complete the survey (one case) or the topic was considered to be too explosive (one case).

Six companies did not state any particular reason for nonparticipation.

Additionally, private households were questioned about the damage to their buildings and household contents due to the flood event in August 2002 as well as about factors that may have influenced the damage. Computer-aided telephone interviews were carried out by the SOKO-Institute, Bielefeld, Germany, in April and May 2003. In total, 1,248 flood-affected households were interviewed in the Elbe catchment area in Saxony and Saxony-Anhalt. The person who had the most knowledge about the flood event in the household was always questioned. Tenants were only asked about their household contents and related losses. To complete the interview the building owner was also called and asked about the building and flood-related damage to it. On average, an interview lasted 30 minutes. The interview consisted of approximately 180 questions addressing various topics. In this article, only questions addressing insurance coverage, mitigation measures undertaken before and after the flood, emergency measures undertaken during the flood, flood risk awareness, flood experience, and absolute losses are analyzed. For more details and results of the survey, see Kreibich *et al.* (2005) and Thieken *et al.* (2005).

3. RESULTS AND DISCUSSION

3.1. General Conditions of Natural Hazards Insurance in Germany and its Market Penetration

In Germany, private insurance companies have provided natural hazards insurance as a supplement to building or contents insurance since 1991. This supplemental contract covers losses due to floods, torrential rain, earthquakes, land subsidence, avalanches, and snow buildup. By default, losses due to windstorms and fires are covered by any building insurance policy. Losses due to storm surges are an uninsurable risk in Germany (GDV, pers. comm., 2003). Our survey among insurers revealed that 70% of the companies also provide coverage for losses due to backwater in stormwater drainage systems, whereas losses caused by a rise in groundwater level are covered only by two companies.

3.1.1. Market Penetration

Building insurance, which covers windstorm and fire losses, has a widespread market penetration of

90% in Germany (GDV, pers. comm., 2003) since banks usually demand it to secure loans (Schwarze & Wagner, 2004). This does not apply to the above-mentioned supplemental coverage for other natural hazards. In most parts of Germany its current market penetration is estimated to be approximately 10% for household contents and 4% for residential buildings (GDV, pers. comm., 2003). However, there are two regions with a higher insurance density: Baden-Wuerttemberg and the territory of the former German Democratic Republic (GDR). Flood loss compensation was generally included in mandatory building insurance in Baden-Wuerttemberg until 1994. Due to EU regulations this monopoly insurance had to be abandoned. Currently, more than 80% of the property owners in Baden-Wuerttemberg still have flood insurance coverage (Kron, 2004). Flood loss coverage was also provided by the household insurance in the former GDR, which Saxony and Saxony-Anhalt were part of. Thirty to fifty percent of people in the new German states (former GDR) still have comparable contracts (Mechler & Weichselgartner, 2003; Kron, 2004). In our survey of affected private households in Saxony and Saxony-Anhalt about half of the interviewed people (49.5%) in the Elbe catchment area were insured against flood damage in August 2002 (Fig. 1).

3.1.2. The Flood Hazard Zoning System ZÜRS and Insurability

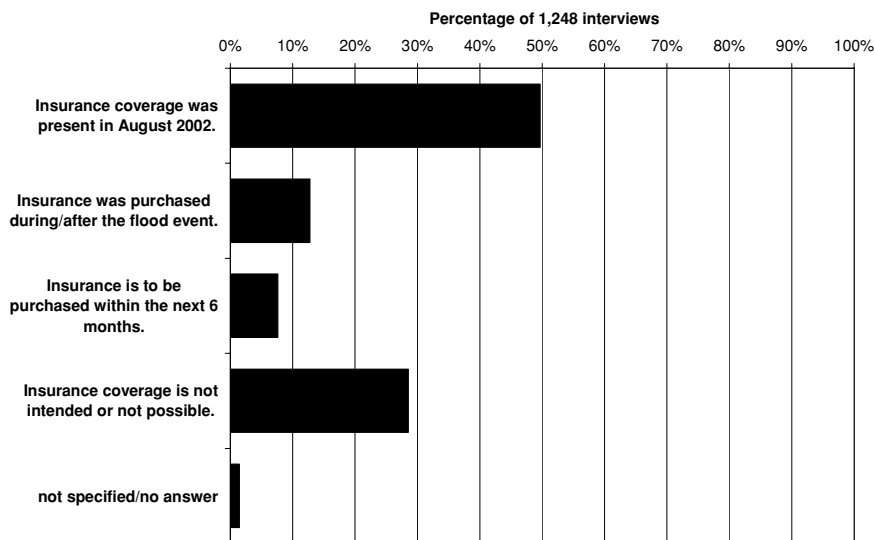
Particularly hazard-prone buildings are often excluded from flood insurance or are only insured if

high premiums are paid. The premise for a transparent rating is a consistent hazard zoning system. Since national flood hazard maps do not exist in Germany, a countrywide zoning system for inundation (ZÜRS) was developed for insurance purposes, lead managed by the GDV. In the first version of ZÜRS, launched in 2001, three hazard zones with different probabilities of inundation (Table I) were identified for 55,000 km of river reaches (Kriebisch, 2000; Kleeberg, 2001). After the August 2002 flood, a fourth zone corresponding to the 200-year flood was introduced. Table I shows the insurability of buildings in the different zones. Buildings in the high-risk zone, where flooding occurs on average at least once in 10 years, are generally not insurable. Buildings in the zones with moderate and low risk are insurable if enough accumulation cover exists. Buildings with a very low inundation risk are always insurable. The introduction of the fourth zone and the enhanced control of risk accumulation will probably lead to a significant increase in the noninsurable area (currently 10%) (Schwarze & Wagner, 2004).

The survey among insurers revealed that, in addition to the ZÜRS zoning, the number of preceding flood losses and the distance to the water bodies play a crucial role in risk assessment (Table II). Table II also illustrates that after the 2002 flood, risk assessment has been carried out more precisely, particularly by a more widespread use of ZÜRS.

In general, an insurance application is allowed if the insured object is situated in the old ZÜRS Zone I and if no previous damage has occurred in the past 10 years (Table III). If the criteria in Table III are

Fig. 1. Flood insurance coverage in 1,248 private households affected by the August 2002 flood in Saxony and Saxony-Anhalt (data source: survey of affected private households).



Zone (Old)	Zone (New)	Hazard	Average Statistical Return Period of Being Inundated	Current Insurability
I	I	Very low	At maximum once in 200 years	Fully given
I	II	Low	Once in 50–200 years	Basically given
II	III	Moderate	Once in 10–50 years	Basically given
III	IV	High	At least once in 10 years	Generally not given

Table I. ZÜRS Flood Hazard Zones and Insurability (Modified from Kron, 2003)

not met, then only about 30% of the surveyed insurers grant insurance coverage with special conditions, among which are a raised insurance premium (four entries), a raised deductible (four entries), and/or building upgrading and retrofitting (three entries).

In general, conditions of existing insurance contracts will not be altered after the flood in 2002. However, when new contracts are signed, one-third of the surveyed companies have announced an increase in insurance premiums and/or deductibles. More than 50% of the companies signaled that they would improve their risk assessment.

Altogether, the survey indicates that natural hazards insurance is routine business. The terms are

Table II. Evaluation Criteria for the Assessment of the Flood Risk of Residential Buildings in the Context of Natural Hazards Insurance (Data: Survey of Direct Insurers)

Criteria	Before the 2002 Flood (Number of Answers)	After the 2002 Flood (Number of Answers)
Number of flood losses in the past 5–10 years	18	18
Horizontal distance to the water bodies	14	15
Hazard assessment according to ZÜRS	13	18
Vertical distance to the water bodies/slope of the land surface	11	12
Assessment of each individual case	10	9
Distance to upstream dams, etc.	6	6
Type of building construction	5	4
Susceptibility of the assets to be insured	1	1
Questionnaire with regard to insurance location and previous losses	1	1
Precautionary measures (if previous losses)	1	1
Valid answers	18	19

Table III. Conditions that Usually Have to be Fulfilled to Acquire Natural Hazards Insurance Coverage for Residential Buildings (Data: Survey Among Direct Insurers)

Criteria	Before the 2002 Flood (Number of Answers)	After the 2002 Flood (Number of Answers)
No previous damage in the past 5 years	17	18
No previous damage in the past 10 years	16	17
ZÜRS Zone I (old zoning, i.e., return period of inundation > 50 years)	11	15
ZÜRS Zone II (old zoning, i.e., return period of inundation between 10 and 50 years)	6	7
At maximum one previous damage in the past 10 years	2	2
Others	3	5
Valid answers	19	20

established in a uniform procedure with little room for negotiation. After the August 2002 flood, more efforts have been put into risk assessment and the conditions have been tightened slightly.

3.2. Flood Loss Compensation and Recovery of Insured and Uninsured Private Households Following the August 2002 Flood

Since nearly 50% of the interviewed private households were insured in August 2002 (cf. Fig. 1), the survey provided a good database for the comparison of insured and uninsured households. As mentioned above, a vast sum of governmental money was available as compensation for 2002 flood losses.

At the time of the interviews in April and May 2003, i.e., 8 months after the flood, loss compensation was not fully completed. In the survey of insurers, some companies estimated that damage regulation

Table IV. Comparison of Total Flood Loss Compensation (Contents and Buildings) in Insured and Uninsured Private Households (Data Source: Survey Among Private Households)

Percentage of Private Households Receiving Loss Compensation of	With Insurance (<i>n</i> = 424)	Without Insurance (<i>n</i> = 389)
At least 50%	67.5%	32.1%
At least 80%	37.5%	15.4%
100%	25.9%	10.3%

would be finished by the end of 2003. Uninsured households could apply for governmental reconstruction aid until the end of May 2003. The source of compensation money (e.g., government funds, donations, or insurance compensation) was not collected in our survey. Thus, a definitive assessment of the differences in loss compensation between insured and uninsured

households cannot be made here. However, the results suggest a trend.

3.2.1. Flood Loss Compensation

In general, the survey revealed a high variability in loss compensation among the affected households. However, at the time of the interviews, the mean flood loss compensation was substantially higher in insured households (Table IV). Table V compares insured and uninsured households with regard to flood impact, flood losses during the August 2002 flood, loss compensation, flood experience, risk awareness, and loss mitigation. Whereas no significant differences in building damage occurred, there was slightly more damage to household contents in insured households.

At the time of the interviews satisfaction with flood loss compensation was higher in insured households: on a scale from 1 to 6, where 1 means "I was very satisfied with the flood loss compensation" and

Table V. Comparison of Insured and Uninsured Private Households with Regard to Flood Impact, Flood Losses During the August 2002 Flood, Loss Compensation by April/May 2003, Flood Experience, Risk Awareness, and Loss Mitigation (Data Source: Survey Among Private Households); Significance Was Tested with the Mann-Whitney-U-Test

	With Flood Insurance	No Flood Insurance	Significance
Damage			
Mean building damage	52,276€	52,001€	No
Mean damage to household contents	17,440€	16,779€	<0.05
Recovery			
Mean loss compensation	23,749€	12,540€	<0.01
Mean satisfaction with loss compensation (scale from 1 to 6)	2.01	2.44	<0.01
Mean recovery from building damage assessed on a scale from 1 to 6	2.94	3.07	No
Mean recovery from household content damage assessed on a scale from 1 to 6	2.40	2.57	No
Flood experience and risk awareness			
Mean number of experienced previous floods	0.47	0.28	<0.01
Percentage of people without flood experience, but with knowledge about the flood hazard	36%	26%	<0.01
Assessment of being affected by future floods (scale from 1 to 6)	3.30	3.29	No
Mitigation			
Mean indicator for acquiring relevant information before August 2002	0.62	0.41	<0.01
Mean indicator for building mitigation measures before August 2002	0.53	0.32	<0.01
Assessment of the effectiveness of private mitigation measures on a scale from 1 to 6	3.33	3.24	No
Mean indicator for performing emergency measures	38.24	36.58	No
Mean time spent on emergency measures (h)	20.52	22.28	No
Flood impact			
Mean flood-water level (above ground) (cm)	94.98	97.77	No
Mean flood duration (h)	184.48	177.05	No
Mean indicator for flood contamination	1.59	1.5	No

6 “I was not at all satisfied with the flood loss compensation,” 75% of the insured interviewees were very satisfied, i.e., they chose a “1” or “2” on the rank scale. This percentage dropped to 60% in the uninsured households. The following reasons for dissatisfaction were most frequently mentioned: insufficient loss compensation, excessive waiting and processing times, and overly complicated and bureaucratic handling of the claims, as well as delay or denial of payment.

3.2.2. *Recovery*

The affected persons were asked to compare the state of their household contents and buildings before the flood and at the time of the interview, and to evaluate the difference on a rank scale from 1 (= household contents/buildings are already completely replaced/restored) to 6 (= there is still considerable damage to household contents/to the building). Approximately 8 months after the flood, 42.1% of the insured persons evaluated building status with a “1” or “2”, i.e., had already recovered well. For household contents this figure increased to 61.0%. A score of “5” or “6”, indicating insufficient recovery, was given in 15.9% (buildings) and 10.5% (household contents) of the answers, respectively. In uninsured households, only 35.0% evaluated their recovery with a “1” or “2” with regard to building damage and 55.5% with regard to damage to household contents. Only 14.9% (buildings), but 15.1% (household contents) of the interviewees in uninsured households gave a score of “5” or “6.” Although the recovery in insured households was slightly better, the differences between the mean recovery in insured and uninsured households are not significant (Table V).

3.2.3. *Discussion*

All in all, our analysis demonstrates that, despite extensive governmental disaster assistance after the August 2002 flood, insured private households were compensated earlier and most likely to a greater extent, and have thus recovered a little, but not significantly, faster than uninsured households. Although intended by the government, there was no complete reconciliation of compensation paid by governmental agencies and insurance companies. Thus, the possibility cannot be ruled out that some insured households also received money from the governmental emergency fund or that some were even compensated twice. The extent of overcompensation

cannot be determined since the source of compensation money was not collected in this survey.

Despite the better compensation, 29% of the surveyed private households still did not intend to purchase insurance (Fig. 1). The increase in requests for natural hazards insurance right after the flood declined again after a couple of months (GDV, pers. comm., 2003).

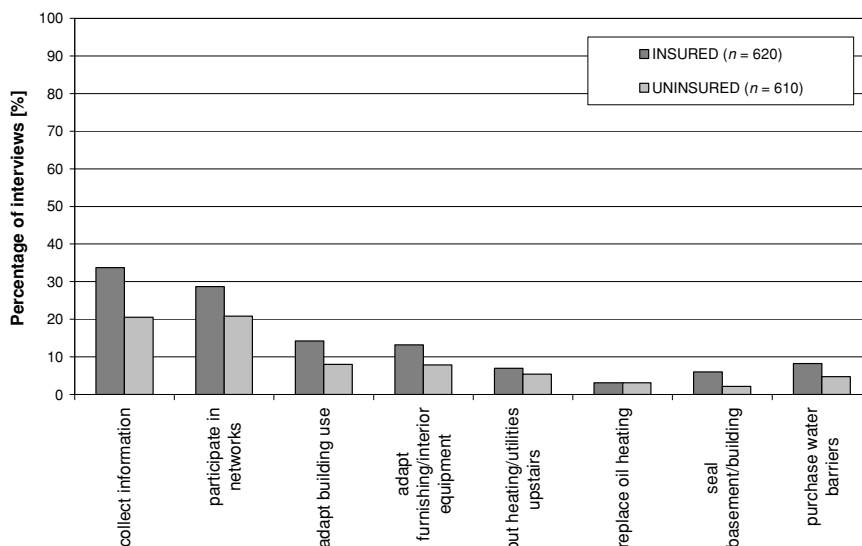
3.3. Insurance Coverage, Risk Awareness, and Mitigation Measures

The survey of private households also provided a good database for comparing risk awareness and loss mitigation in insured and uninsured households. Since risk awareness and mitigation activities were expected to be influenced by flood experience, this aspect was analyzed first. Among the surveyed insured households, 18% had experienced at least one previous flood, whereas this applied to only 12% of the uninsured households. People without flood experience also showed a significant difference in knowledge about the flood hazard of their residence (Table V): 35% of the insured households without flood experience declared that they had known about their living in a flood-endangered area. This applied to only 26% of the uninsured households without flood experience. Both groups, however, estimated a similar probability of being affected by future floods (Table V).

3.3.1. *Loss Mitigation Measures Before August 2002*

It is often alleged that people with flood insurance do not attempt to prevent or mitigate flood damage. The survey among private households, however, indicated that the time spent on performing emergency measures and the kinds of measures undertaken do not differ significantly between insured and uninsured households (Table V). In the runup to the August 2002 flood, insured households tended to be even better informed about mitigation and tended to flood proof their building more often than uninsured households (Table V, Fig. 2). Of the insured households, 48.5% had acquired information regarding flood mitigation or participated in emergency networks, whereas only 33.9% of the uninsured households had done likewise. Of the insured households, 28.5% had performed at least one of the mitigation measures shown in Fig. 2, whereas this was true for only 20.5% of the uninsured households. Thus, all in all, the knowledge and willingness to engage in

Fig. 2. Differences between insured and uninsured private households with regard to precautionary measures: implementation of mitigation measures before the flood event in August 2002 (data source: survey of private households).



self-protecting behavior were slightly better developed in insured households than in uninsured.

3.3.2. Mitigation Measures Undertaken After the August 2002 Flood

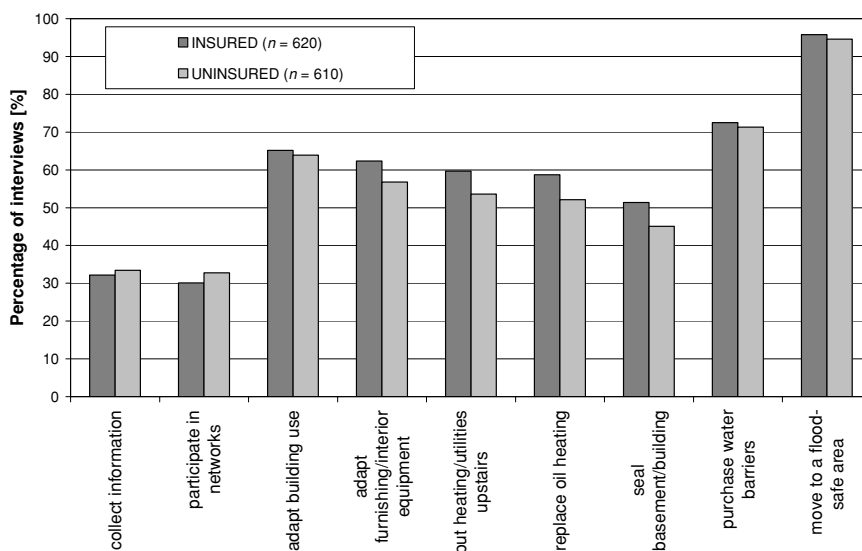
Although many households had performed mitigation measures in the aftermath of the flood, there was still a considerable percentage of people who did not intend to invest in mitigation in the future (see Kreibich *et al.*, 2005). This percentage was slightly higher in insured households, especially with regard to flood proofing the building (Fig. 3). Of the insured households 33.7% and of the uninsured households

31.2% intended to perform none of the measures shown in Fig. 3. The percentage of people who did not regard private mitigation measures as an effective tool for flood loss reduction (i.e., they chose values from 4 to 6 on a rank scale from 1 to 6, where 1 means “private mitigation measures can reduce flood damage effectively” and 6 “private mitigation measures do not reduce flood damage effectively at all”) was very similar in both groups (Table V).

3.3.3. Discussion

The question arises as to how people can be motivated to invest in loss mitigation. The possibilities,

Fig. 3. Differences between insured and uninsured private households with regard to loss mitigation: percentages of households that did not intend to implement mitigation measures in the future (data source: survey of private households).



costs, and expected benefits (in terms of reduced loss) of private mitigation measures should be better communicated to the public. Several German ministries have published information to encourage people to undertake mitigation measures (BMVBW, 2002; MURL, 2000; MUF, 1998). A few studies have even given quantitative information about flood loss reduction due to mitigation measures (FEMA, 1998; ICPR, 2002; Kreibich *et al.*, 2005). Average extra repair costs for using water resistant material or altering building use, and loss savings for a shallow and a deep flood-water level for measures for specific house types were determined by the Association of British Insurers (ABI) for a couple of typical houses (ABI, 2004). For some measures, like replacing floors and joists with treated timber to make them water resistant or moving the washing machine to the first floor, flood loss reduction already exceeds the extra repair costs if only one shallow flood (water level up to 5 cm) occurs (ABI, 2004). For definitive cost-benefit analyses, the specific situation and properties of the house must be taken into consideration, as set rules and generalizations may be misleading.

Jakli (2003) suggested that banks could also encourage insurance coverage and mitigation. After the 2002 flood it became evident that uninsured people with loans posed a financial risk to banks because their flood losses caused insolvency. Therefore, Jakli (2003) suggested that banks pay special attention to appropriate insurance coverage when customers apply for a loan. This could also be a way to strengthen land-use regulation and building codes through insurance coverage and the granting of loans.

3.4. The Role of Insurance Companies in Flood Risk Management in Germany

In the framework of flood risk reduction, insurance coverage should be combined with loss mitigation measures.

A well-established instrument to encourage private loss mitigation in the context of insurance is the deductible: in case of a damaging event the insured has to pay for part of the damages himself or herself and should consequently be interested in reducing future damage. Ideally, the deductible should be linked to the risk of the insured object so that particularly high-risk households have the strongest incentive to undertake mitigation measures. The survey among insurance companies revealed that all insurers charge a deductible, but none was linked to the flood hazard zones. Commonly, the deductible amounted to 10% of the total loss (true for 45% of valid an-

swers concerning building insurance, 41% of valid answers concerning contents insurance), followed by a fixed percentage of 1–10% of the insured sum (true for 30% of valid answers concerning building insurance and 36% of valid answers concerning contents insurance), and a fixed deductible (true for 25% of valid answers concerning building insurance, 18% of valid answers concerning contents insurance). In most cases, the deductible for private households amounts to a minimum of 500 euro, to prevent minor losses, and to a maximum of 5,000 euro.

Insurance companies could do even more to improve private mitigation activities. For example, they could encourage policyholders to reduce their susceptibility by informing them about flood-adapted building use and materials, and about behavior in case of a flood event, as well as by rewarding the implementation of building codes (see Sections 1 and 3.3). The survey of German insurers revealed that only 14% of the surveyed insurers rewarded voluntary private mitigation measures. For example, despite previous flood losses or ZÜRS Zone I or II, insurance coverage was allowed if the building was sealed, the basement used in a flood-adapted manner, or if a locking device for the prevention of backwater was installed. In standard risk cases voluntary loss mitigation measures were not rewarded, e.g., by lower premiums or lower deductibles.

On demand, 80% of the surveyed insurers informed building owners regarding which hazard zone they were living in. However, only 25–35% of the insurers gave advice on how to mitigate flood losses. None of the surveyed companies provided information on flood loss reduction.

These results contradict the role in flood risk management to which the surveyed insurers credit themselves: the role of the insurance sector in the revision, implementation, and advancement of technical standards for flood loss reduction as well as in the informing and advising of the insured was assessed relatively high (Fig. 4). However, Fig. 4 points out that the surveyed insurers are not really sympathetic toward active participation in land-use regulation, precautionary measures for buildings, and disaster response. A decisive role was only given to the promotion of the compilation of flood hazard maps in Germany, which can probably be explained by the successful development of the zoning system ZÜRS.

3.4.1. Discussion

The inadequate promotion of flood loss mitigation by insurers is probably due to the fact that

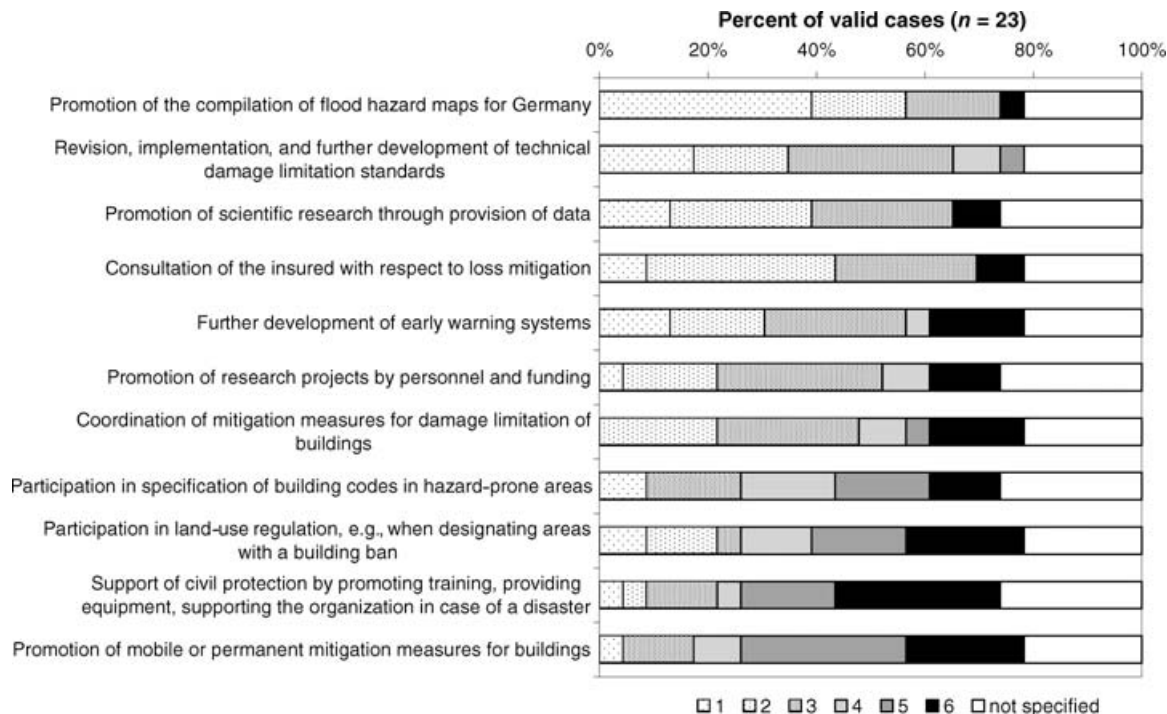


Fig. 4. Assessment of the future participation of insurance companies in flood risk management in Germany on a scale from 1 to 6, where 1 means “insurance should play a decisive role” and 6 means “insurance should not participate” (data: survey among insurers). Measures are sorted in decreasing order of average assessment rank.

building and/or contents insurance belong to routine business, in which profits are relatively low. Therefore, expenses for consultancy, appraisal, and control of mitigation measures are too high in comparison to premiums and profit margins. Further, if deductibles or premiums were to be reduced because loss mitigation measures were taken, the insurance companies would have to be sure that the products used work properly. This has prompted the GDV to establish a working group with the goal of certifying products for flood loss reduction (GDV, pers. comm., 2003). In the United Kingdom, for example, such a certification scheme came into force in 2003. Some insurers have already indicated that buildings fitted with these certified products may be eligible for building insurance coverage on more favorable terms (Wordsworth & Bithell, 2004).

It also became apparent in the survey that many insurers are not well informed about flood risks and possibilities for flood loss mitigation. The survey revealed that, in contrast to reinsurance companies, most of the insurers did not know the probable maximum accumulation loss (PML) of their portfolio.

After the flood in August 2002, the GDV calculated a PML for Germany with an assumed return period of 200–300 years that amounted to 10–15 billion euro for residential buildings only (GDV, pers. comm., 2003). These calculations were made as input for negotiations about compulsory natural hazards insurance (including high-risk areas and losses due to storm surges, see Schwarze & Wagner, 2004). Although the insurance industry had generally given up their negative attitude toward a compulsory insurance, no final agreement could be reached between the insurance industry and the German states (*Deutsche Länder*).

4. CONCLUSIONS

Despite the availability of insurance covering damage due to natural disasters, government funding and public donations played an important role in the compensation of losses resulting from the August 2002 flood. The high level of governmental disaster assistance in 2002 has not really encouraged people to prepare themselves for future disasters. In addition, insurers barely reward mitigation measures in

private households. Although it has to be acknowledged that many of the affected people invested in loss mitigation, our analysis shows that about one-third of the interviewed affected households neither purchases insurance nor invests in loss mitigation. Thus, people seem to have little moral hazard. Since it is unclear how much governmental assistance will be given after future floods, this is alarming behavior and calls for better communication regarding flood risks and (private) mitigation measures.

Furthermore, our analysis shows that, despite the high level of government financial support, insured households in the Elbe catchment area received loss compensation earlier. These households also showed a slightly better risk awareness and preparedness. A considerable share of insured households in the investigation area had voluntarily invested in mitigation measures. Mitigation seems to be related to flood experience or people's knowledge about their living in a flood-endangered area, since these variables also differ significantly between the surveyed insured and uninsured households. Thus, informing people about the flood hazard of their residence and possibilities for flood insurance and flood loss mitigation would be a first step in strengthening the disaster preparedness of private households. In addition, insurance companies should acknowledge the mitigation activities of private households through incentives.

If building loans were coupled with appropriate insurance coverage and if insurance coverage was better combined with precautionary measures in building construction, a substantial reduction in flood risk would result.

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