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Disaster Loss Financing in Germany – The Case of the Elbe River Floods 2002

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Abstract

In August 2002, floods in central Europe caused damage of about € 15 billion; insured losses were about € 3.1 billion. According to Munich Reinsurance, this was the most expensive natural disaster of the year 2002. In Germany, heavy rains led to some of the worst flooding the Free State of Saxony has witnessed in more than a century. In Dresden, the Elbe River rose from a normal summer level of about two meters to 9.13 meters surpassing the historical flood mark of 8.77 meters seen in March 1845, to reach on August 17, 2002, a water level of 9.40 meters – the highest level that has ever been recorded in Dresden.

Shortly after the flood event, overall damage in Germany was estimated to be € 22 billion, which in December 2002 was revised to about € 9.1 billion of direct losses. Concerning the regional distribution of losses, Saxony was hit hardest. With direct damage of € 6.084 billion the federal state bears 67% of the total losses. About 14.9% (€ 1.353 billion) of the overall damage is corresponding to the German government and 11.3% (€ 1.029 billion) to the state of Saxony-Anhalt.

The major share of about € 3.316 billion accrued to state and municipal infrastructure (36.6%), federal infrastructure losses were € 1.353 billion (14.9%); private households suffered about € 2.547 billion of losses (28.1%), followed by private companies with € 1.438 billion (15.9%).

The compensation of the flood losses was mainly financed by a special disaster relief and reconstruction fund set up by both the National Government and the federal states of Germany. This so-called *Sonderfonds Aufbauhilfe* amounted to € 7.1 billion, or seventy-eight percent of total direct losses. Other sources of financing were the insurance (estimated to amount to € 1.8 billion), an European Union emergency fund (€ 444 million), and public donations (€ 243 million). Total financing available amounting to 9.6 billion Euro thus exceeds the direct losses incurred, which will only be financed.

Considering that government compensation will be provided in terms of replacement costs rather than current value lost, still all direct losses could be compensated in theory**.** Compared to total compensation provided in other major events in developed countries, which on average amounted to 45% of total losses, this large financing provided is exceptional. This can be attributed to the following factors: the floods constituted the largest losses ever in Germany and were commonly considered an event with a return period of less than 1000 years (*Jahrtausendhochwasser*, millenium floods); the floods mainly affected East Germany that is still struggling economically and where unemployment is high; some observers cite the "hot" election phase as federal elections were in their final stages of what was known to be a very close election.

The provision of government funds to the affected private households and companies and municipalities was and is governed by a set of principles that were explicitly set out by the government in order to guarantee the efficient allocation of the funds, allow quick reconstruction and provide and keep incentives for ex-ante measures. These principles include: subsidiarity (the delegation of responsibilities to the lowest administrative level feasible), parallelity *(*reconstruction in the affected East German region was and is parallel and independent of *Aufbau Ost* (reconstruction in East Germany after reunification), provision of Incentives (inclusion of deductibles in order to maintain incentives for mitigation and insurance), efficiency (financing of direct losses only to primarily compensate those worst affected), and the ability to rebuild (loss financing was provided in terms of reconstruction costs rather than current values).

Regarding financing on the municipal level, the Saxon cities of Dresden and Pirna were examined since both experienced large damages to their infrastructure and public assets: Dresden € 400 million, equaling forty-seven percent of the municipal budget of 2002, and Pirna € 22 million or thirty-five percent as a fraction of the budget. The cities expect to be reimbursed ninety percent of their damages in the currently ongoing financing negotiations. Also, large losses were suffered by the private households and business, however, these will not be compensated by the local governments but by the *Sonderfonds Aufbauhilfe*. Households can expect to receive eighty percent of their losses, businesses up to seventy-five percent.

Acknowledgments

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Disaster Loss Financing in Germany – The Case of the Elbe River Floods 2002

Reinhard Mechler, Juergen Weichselgartner

1 Introduction

Roughly one third of all losses due to nature's forces can be attributed to flooding; in the last fifteen years of the 20th century flood losses amounting to more than US$ 250 billion had to be born by societies all over the world (MUNICH RE 1999: 65). In Europe, the last extreme flood events occurred in August 2002. Severe flooding along the Elbe River and its tributaries caused billions of Euro of damage in Germany and the Czech Republic. Moreover, the Danube River damaged infrastructure in Southern Germany, Austria, and Hungary.

Table 1: Costliest floods in recent years (original values in US$ bn, not adjusted for inflation)

Rank	Year	Country (mainly affected regions)	Economic Losses	Insured [%]
1	1998	China (Yangtze, Songhua)	31.0	3
2	1996	China (Yangtze)	24.0	2
3	1993	USA (Mississippi)	21.0	6
4	1995	North Korea	15.0	0
5	1993	China (Yangtze, Huai)	11.0	0
6	**2002**	**Germany (Elbe)**	**9.8**	**< 20**
7	1994	Italy (North)	9.3	< 1
8	1993	Bangladesh, India, Nepal	8.5	0
9	2000	Italy (North), Switzerland (South)	8.5	6
10	1999	China (Yangtze)	8.0	0
11	1994	China (Southeast)	7.8	0
12	1995	China (Yangtze)	6.7	1
13	2001	USA (Texas)	6.0	58
14	1997	Czech Republic, Poland, Germany (Odra)	5.9	13

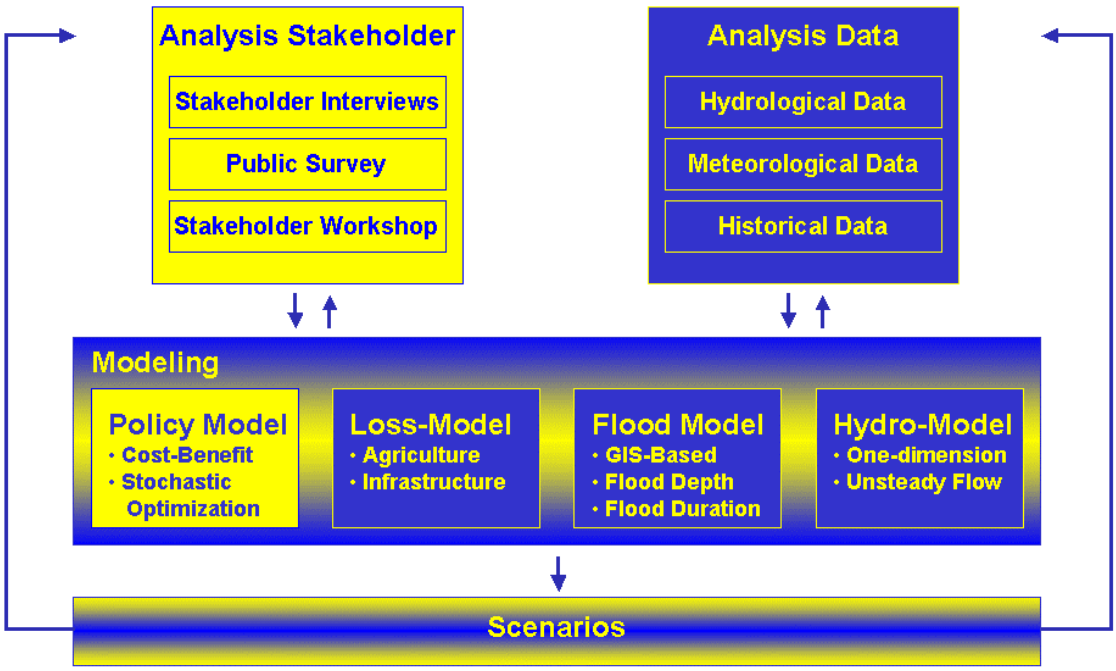
Source: modified after KRON & THUMERER (2002: 3)

The Elbe floods in summer 2002 with losses estimated at about € 9.1 billion were one of the worst flood loss events in Europe and Germany ever (see Table 1). However, whereas in developing countries, often substantial financing resource gaps occur after disasters and a large amount of losses cannot be compensated, in the Elbe floods almost 100% of the necessary financing mainly provided by government sources was available to compensate private households, business and local governments. However, providing such massive compensation naturally raises questions about equity (compensating the insured vs. the uninsured) and maintaining incentives for ex-ante mitigation and risk financing measures to be undertaken by the private sector.

A recent IIASA report investigates the effects of imposing different policy options for a flood risk management program using a system analytical approach (see Ekenberg et al. 2003). Foci of this study are options for designing a public-private insurance and reinsurance system, as well as the analysis of a set of policy packages that could gain consensus among different stakeholders. As illustrated in Figure 1, the integrated catastrophe flood model applied in Hungary included both physical and social parameters. By combining different models, it was demonstrated how an implementation of a simulation and decision analytical model can provide useful insights into flood policy options.

The present report focuses on the analysis of how the losses in Germany, particularly in the federal state of Saxony, were financed and how they were shared between the victims, insurance companies, and the different levels of government in the strongly federalized governmental system typical of Germany. In addition, the report discusses the principles employed to ensure the most efficient use of government funds, to help the affected to recover as quickly as possible and to maintain incentives for ex-ante risk mitigation and financing measures.

Figure 1: IIASA's system analytical approach, applied in the Tisza river basin

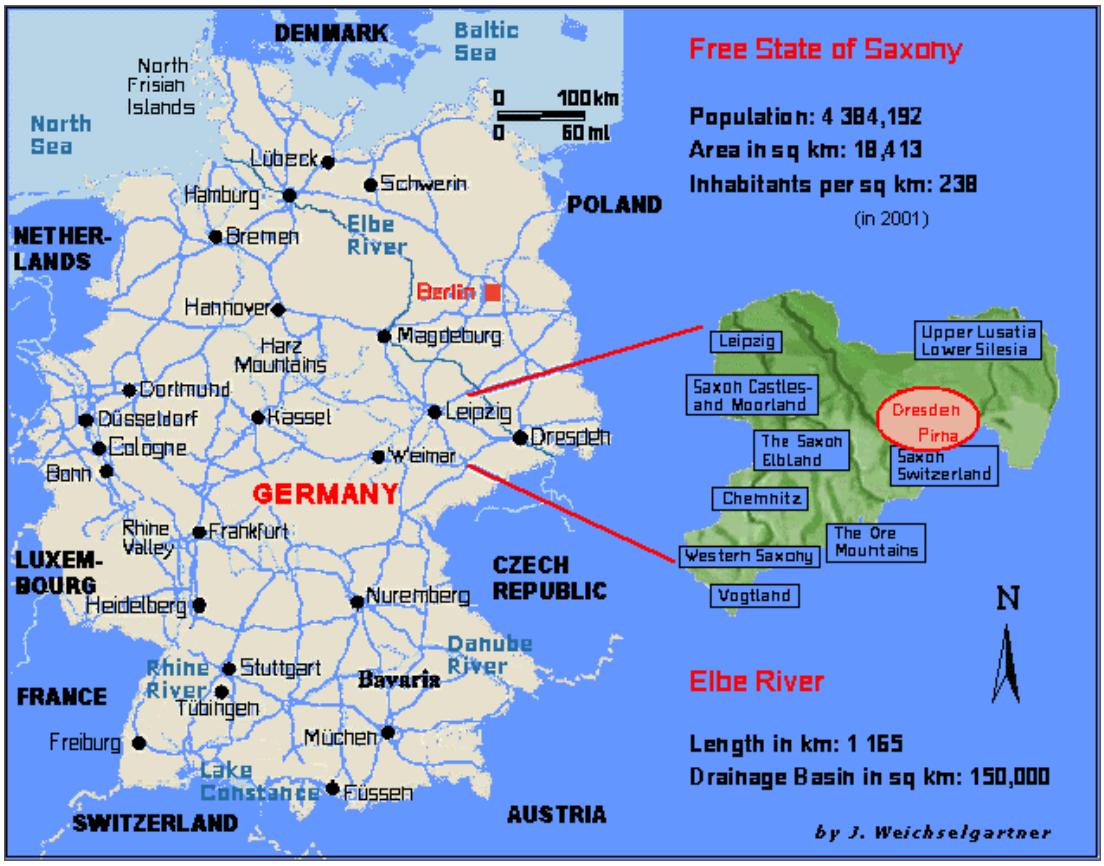


Source: J. WEICHSELGARTNER

The structure of the report is as follows: first, the context of the floods is addressed in chapter 2, ranging from hydrological aspects through response measures to responsibilities. Then, in chapter 3 an analysis of the flood losses is presented using official data gathered through a literature review and expert interviews (the experts interviewed are listed in Annex 3). This sets the stage for a review of loss prevention strategies in Germany as well as the instruments and principles used in financing the losses in chapter 4. Finally, some conclusions are drawn.

Figure 2 gives an overview about the study location; Table 2 shows a general comparative profile of Saxony and the two cities of Dresden and Pirna.

Figure 2: Study location



Source: J. WEICHSELGARTNER

Table 2: General profile of Saxony, Dresden, and Pirna

	Unit	Saxony	Dresden	Pirna
Inhabitants (12/01)	1 000	4 392.7	472.921	41.065
Unemployed (09/01)	1 000	399.3 (19%)	37.662 (16.1%)	3.664 (15.1%)
Trade tax income	10^6 €	499.800 (12/01)	36.832 (12/01)	7.805 (12/00)

Source: Statistical Office of the Free State of Saxony (2002), Stadt Dresden (2002), Stadt Pirna (2001)

2 Elbe River Floods 2002

2.1 Geo-Hydrological Aspects

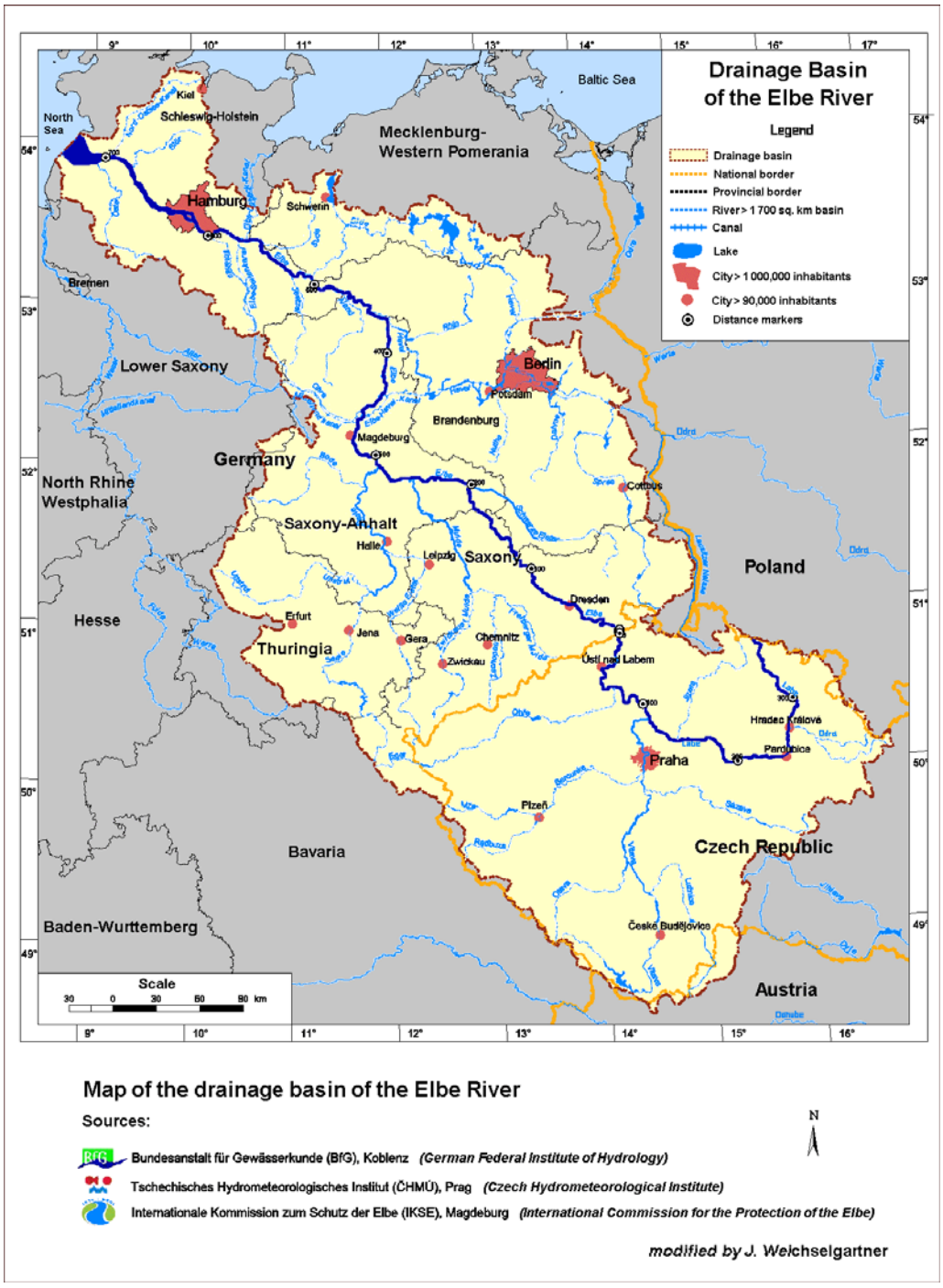
The Elbe River basin covers different geographical regions from middle mountain ranges in the west and south to large flatlands and lowlands in the central, north, and eastern part of the basin (see Figure 3). From its 1394 m high source in the Czech *Krkonose* (*Riesengebirge* in) to its mouth in the German Cuxhaven at the North Sea, the Elbe River (Czech name: *Labe*) has a length of 1165 km (700 km in Germany) and a drainage basin of 148,268 km² (two-third in Germany, one-third in the Czech Republic; see Bundesanstalt für Gewässerkunde 2002: 1). In contrast to flooding, the Elbe region is the driest of the five largest German river basins, so that water stress and water deficiencies occur earlier and more frequently in the case of droughts than in other parts of Germany. According to LAWA (1995) – the so-called *Länder* Working Group on Water which was set up in 1956 as an amalgamation of the ministries of the federal states of Germany responsible for water management and water legislation – eighty percent of former flooding areas have been separated from the streambed of the Elbe River and canals connect the river to the Rivers Weser and Rhine as well as to the River Odra.

Today, there are several monitoring activities in the Elbe River and its tributaries that are coordinated by the International Commission for the Protection of the Elbe (contracting parties are Germany, the Czech Republic, and the EU). In Germany, the "ARGE Elbe" – a working group comprising the federal states of Hamburg, Lower Saxony, Schleswig-Holstein, Saxony, Saxony-Anhalt, Mecklenburg-West Pomerania and Brandenburg – is in charge of monitoring the Elbe.

Starting on August 6, 2002, a complex weather situation over central Europe led to heavy and widespread precipitation in Hungary, Austria, southern-western parts of Czech Republic, as well as eastern and southern Germany. Coming from England, the low pressure system "*Ilse*" passed along the southern part of the Alps and then headed for Saxony in a so-called Vb track. In a ten-day period from August 1 to 10, precipitation of about 60 mm fell widely in the Elbe River drainage basin area, followed by strong rainfall on August 11 through 13 (see Bundesanstalt für Gewässerkunde 2002: 9). The accumulated precipitation (in mm) of the twelve-day-period from August 1 to

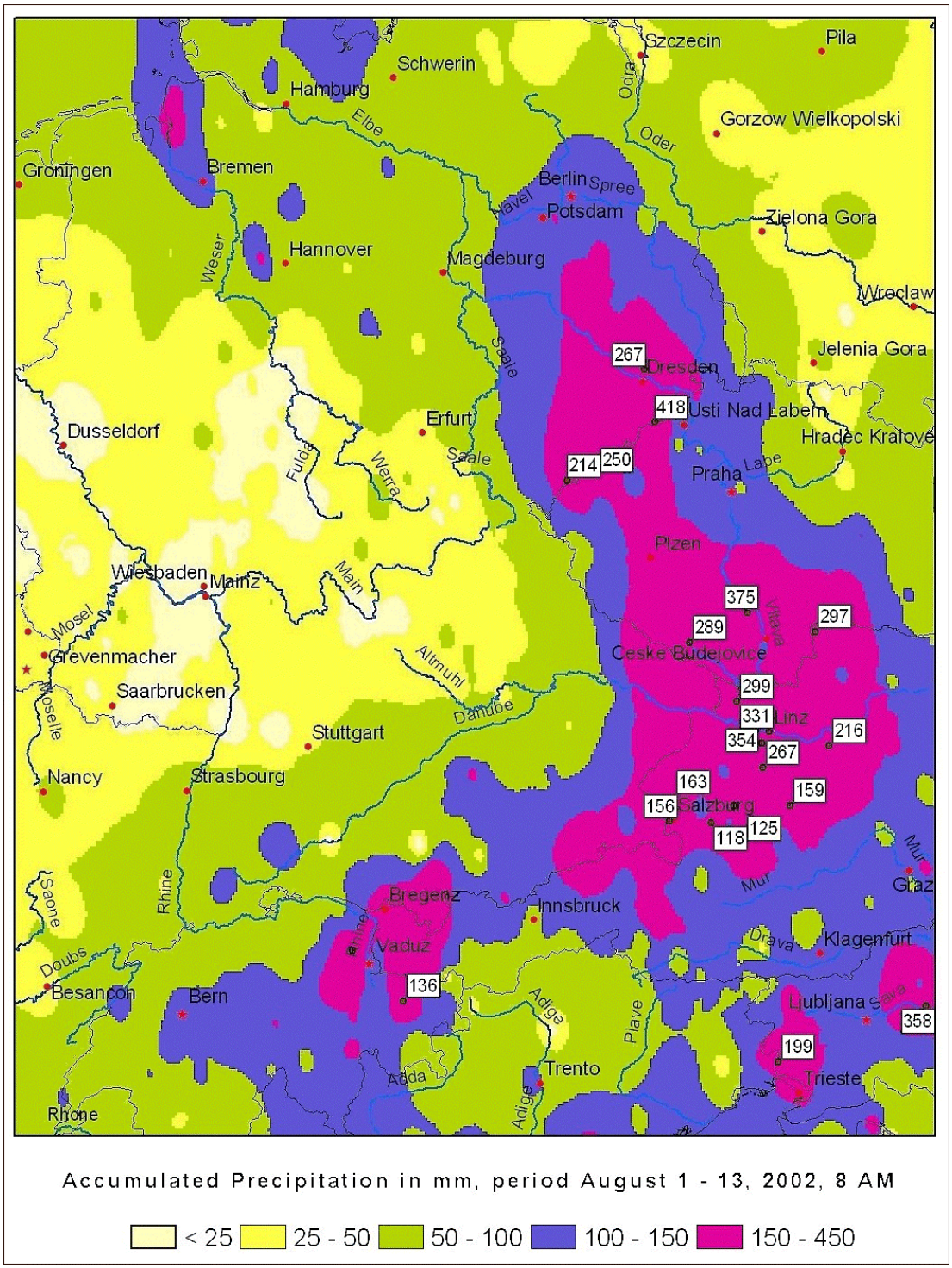
13, 2002, 8:00 AM Central European Summer Time, is shown in Figure 4; the numbers represent the percentage of the average precipitation in August 2002.

Figure 3: Drainage basin of the Elbe River



Source: modified after Bundesanstalt für Gewässerkunde (2002: 45)

Figure 4: Accumulated precipitation from August 1 – 13, 2002



Source: modified after Deutscher Wetterdienst, Global Precipitation Climatology Centre (URL: http://www.dwd.de/research/gpcc)

The complex weather conditions, marked by the rain-bearing, low-pressure system "*Else*" tracking across Europe and a depression occurring slightly earlier south of the Alps, are the direct natural cause of the flooding in 2002. Many areas in southern Czech Republic and eastern Germany had rainfalls of 100 mm to 200 mm; in some areas, precipitation was in only three days two to four times higher than the regular monthly average (see Table 3). Thus the soil's capacity to retain water was exceeded.

Table 3: Accumulated precipitation of selected stations

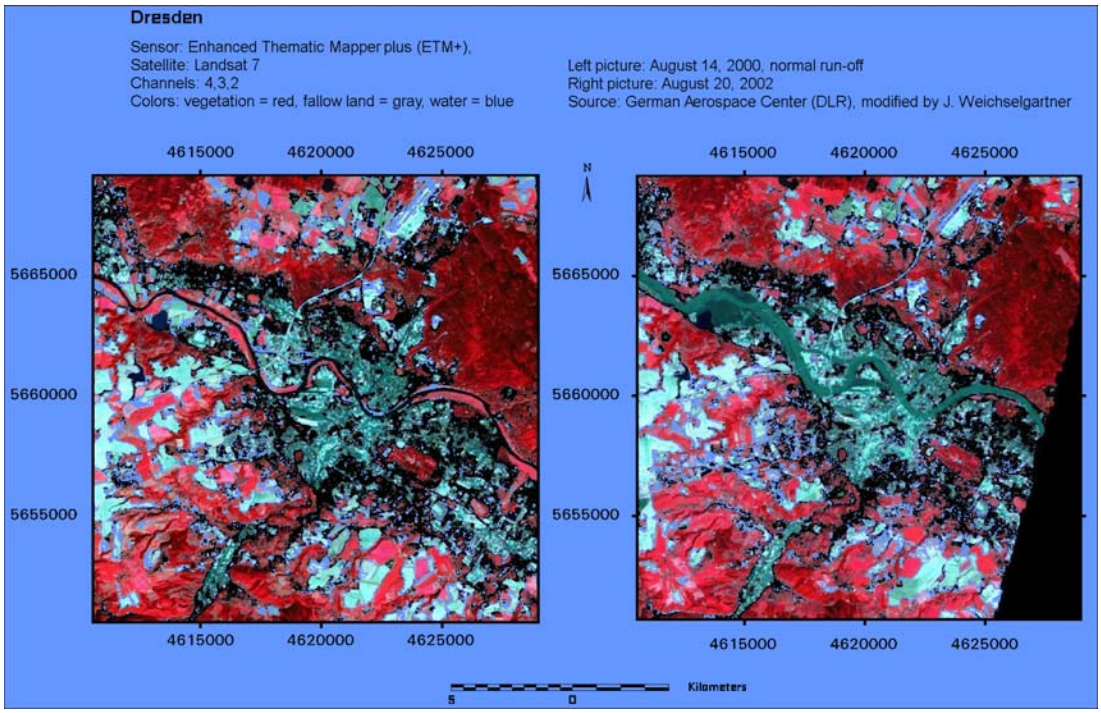
Station	AEo* in km²	Precipitation in mm		
		Aug. 1961/1990	Aug. 1-10, 2002	Aug. 11-13, 2002
Dresden	53,096	71	58	99
Wittenberg	61,879	70	58	102
Aken	70,093	70	60	105
Magdeburg	94,942	71	55	89
Wittenberge	123,532	67	56	85
Neu-Darchau	131,950	65	56	79

* Superficial drainage basin

Source: modified after Bundesanstalt für Gewässerkunde (2002: 13)

In East Germany, the meteorological situation led to flooding on several minor rivers, including the Gottleuba in Pirna, and on the mainstream Elbe River with extremely high water levels causing also widespread flooding in surrounding low-lying areas. Figure 5 – false-color images of the Elbe River and its tributaries taken by the Enhanced Thematic Mapper plus (ETM+) flying aboard the Landsat 7 satellite – shows the dimension of the flooding in 2002. In the right-hand image taken on August 20, 2002, land is primarily green with a little red, water is blue, and cities are slate gray. In the left-hand image taken two years earlier on August 14, 2000, land is primarily red with patches of green, water is nearly black, and cities are purple.

Figure 5: The Elbe River on August 14, 2000, and on August 20, 2002



Source: modified after German Aerospace Center (DLR)
(URL: http://www.dlr.de)

The comparison graphically illustrates the extension of the normal run-off of the Elbe River in summer 2002. Given the heavy rainfall and the maximum water levels reached in August 2002, it is no surprise that both banks and dams have been destroyed, resulting in an inundated area of about 300 km². In Table 4 both historical water levels and water heights observed in 2002 are listed comparatively. The high numbers of new records (in bold) underline the extremity of the 2002 floods.

The comparison with historical floods demonstrates that the floods in 2002 can be considered as an extreme event (see Table 5). In Dresden, on August 17 the Elbe River rose from a normal summer level of about two meters to 9.40 m, surpassing the historical flood mark of 8.77 m recorded on March 31, 1845, by 63 cm, indicating that the flood was of a magnitude that would be observed once in 300 years in terms of the flow rate and once in 200 years in terms of the water level.

Table 4: Water levels in 2002 at different gauge stations

Gauge station	River km*	Highest W in cm		Elbe Flood 2002**
		Date	W in cm	
Usti n. L.	-38,70	-	1119	**1185**
Schöna	2,10	April 1941	868	**1202**
Dresden	55,60	March 1845	877	**940**
Riesa	108,40	March 1988	755	**945**
Torgau	154,60	March 1940	863	**945**
Wittenberg	214,10	November 1980	624	**707**
Aken	274,80	March 1845	740	**765**
Barby	295,50	March 1845	733	700
Magdeburg	326,60	February 1941	701	670
Tangermünde	388,20	March 1981	670	**767**
Wittenberge	454,80	January 1920	715	**734**
Schnackenburg	474,60	April 1988	692	**751**
Dömitz	504,70	March 1888	744	657
Neu Darchau	536,40	April 1895	724	**732**

* Point Zero is the Czech-German border ** New records in bold

Source: modified after Bundesanstalt für Gewässerkunde (2002: 32)

Table 5: Elbe River floods since 1500, gauge station Dresden

Rank	Date	W in cm	Q in m3/s	Rank	Date	W in cm	Q in m3/s
1	**17 August 2002**	**940**	**ca. 5,000**	14	30 June 1698	765	3,400
2	31 March 1845	877	5,700	15	3 January 1651	755	3,200
3	1 March 1784	857	5,200	16	1 May 1531	753	3,200
4	16 August 1501	857	5,000	17	28 June 1824	753	3,169
5	7 February 1655	838	4,800	18	11 April 1865	748	3,300
6	6/7 September 1890	837	4,350	19	4 March 1827	746	3,078
7	3 February 1862	824	4,493	20	27 March 1814	739	2,987
8	24 February 1799	824	4,400	21	22 April 1785	737	2,950
9	2 March 1830	796	3,950	22	18 January 1682	735	2,900
10	17 March 1940	778	3,360	23	27 March 1895	734	3,037
11	20 February 1876	776	3,286	24	7 May 1896	732	3,070
12	11 April 1900	773	3,200	25	28 March 1821	732	2,896
13	17 January 1920	772	3,190	26	25 March 1886	727	2,929

Source: modified after DEUTSCH (2000: 34)

Pirna and particularly its historical town is even higher exposed to flooding since it is not only located at the Elbe River but also at the Gottleuba River. Although of a much smaller size, the latter caused disastrous floods in 1927 and in 1957. Figure 6 shows the flood exposure of Pirna and the flood consequences using the *Dohnaische Strasse* (a downtown shopping street in Pirna) on August 20, 2002, as an example.

Figure 6: Flood exposure and damage in Pirna

Source: modified after City of Pirna, photo by Lutz HAUPTMANN
(URL: http://www.pirna.de/html/wirtschaft.html)
(URL: http://www.lutz-hauptmann.de/webcam/hochwasser/index7.html)

2.2 Disaster Management Aspects

2.2.1 Mitigation

In Germany it is the legal obligation of the public sector to protect the population from natural disasters. Concerning flood disaster management, measures to be provided by the state include structural measures, such as dams and retention basins, and non-structural measures, such as monitoring, forecasting and early warning systems. In practice, flood control measures are principally the responsibility of the *Länder*, but the federal state also has statutory responsibility for flood protection (see Table 6). Due to the federal system, a variety of legislation concerns water management, such as, the W*asserhaushaltsgesetz* (Water Management Act), *Bundesnaturschutzgesetz* (Federal Nature Conservation Act), *Bundesbaugesetz* (Federal Construction Act), *Umweltver-träglichkeitsprüfungsgesetz* (Environmental Assessment Act), *Wasserverbandsgesetz* (Water Associations Act), and the *Bundeswasserstrassengesetz* (Federal Waterways Act) (see PORTMANN & GERHARD 1997: 49).

Table 6: Competence in Germany concerning flood protection

	Competence
Legal embodiment	Primarily, Water Resources Management Act and *Länder*-specific water laws. However, there are several other competence schemes related to flood management, such as, Water Associations Act, Federal Waterways Act, Drinking Water Ordinance, and the Waste Water Billing Act.
Responsibilities	*Länder* Ministry of the Interior as highest disaster protection authority; districts and city authorities as subordinate disaster protection authorities.
Instruments	Flood prevention plans, upkeep and maintenance plans for flood prevention plants and flood forecasting, early warning systems.

Source: J. Weichselgartner

The characteristic flood control measure in the Elbe River basin are dikes and, as mentioned above, the federal state is responsible to maintain the dikes, along small waterways the local communities. In total, around 127 km along the Elbe River are protected by dikes providing protection generally for floods with a hundred-year recurrence interval (see Table 7, to give a point of reference: the length of River Elbe within Dresden's city boundary is 30 km). However, the floods in August 2002 are statistically considered a millennium flood and thus exceeded many protection

structures. Moreover, 93 km of the dikes along the Elbe River are built before 1900 and 32 km are built between 1900 and 1945. This inhomogeneous structure results in a decrease in reliability. What's more, a great number of flood damage occurred in small basins without adequate flood protection.

Table 7 also shows the existing retention basins. This type of flood control measure is often demanded, especially after flooding has occurred. However, the creation of retention basins is not easy since space is usually limited. Also in Germany, a total restoration of natural flood plains is politically and practically infeasible and accordingly the planning of retention basins is limited to a few sites. Moreover, the construction of retention basins requires considerable public resistance to be overcome, with the result that long lead times are required for the process from planning to acceptance of the development plan.

Table 7: Dikes and retention basins in the Elbe River drainage basin

	Dikes	
River	**Length in km**	**Height in m**
Elbe	127.1	1.6 – 4.7
Biela	0.3	0.9 – 1.1
Dahle	6.6	1.5
Weinske	22.0	1.0 – 3.0
	Retention Basins	
River	**Location (District)**	**Seize in ha**
Elbe	Dresden	1557.0
	Riesa-Großenhain	1010.0
Jahna		460.0
Döllnitz		145.0
Wesenitz	Bautzen	201.0
Total		**3 373.0**

Source: modified after Sächsische Staatsregierung (2002a: 48 and 54)

In addition, a structural flood measure that is quite unusual in Germany should be mentioned in this report: relocation. Röderau-Süd, a section of Dresden with about 400 inhabitants (over 130 families) developed during the last decade and totally flooded in August 2002, is planned to be relocated and the house owners compensated (interview

with U. KRAUS, December 10, 2002). Many argue that both the German suffix *Au* – which means natural flood plain – and Figure 7 indicate that this area should not have been developed. Today, the relocation measure may costs € 50 million (LACHMANN 2003: 26).

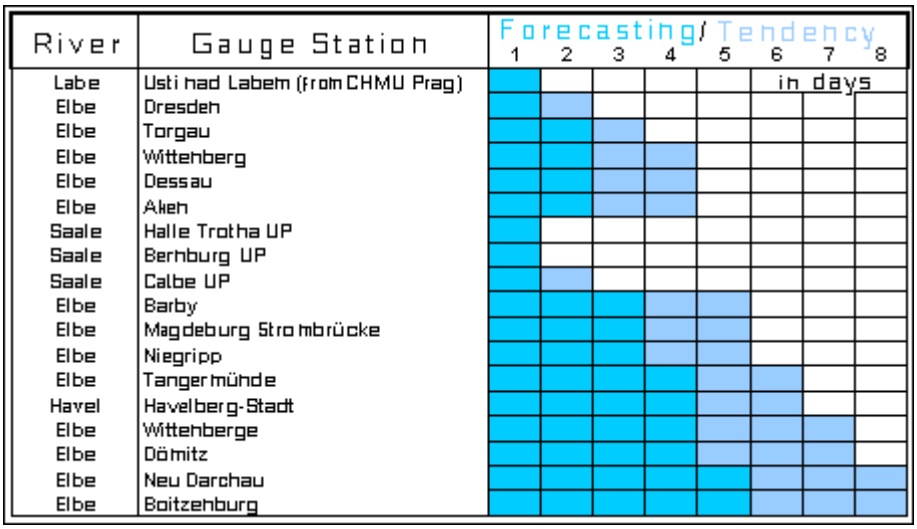
Figure 7: The flooded quarter of Röderau-Süd

Source: Photo by Sachsenspiegel
(URL: http://www.mdr.de/sachsenspiegel/)

The fact that both the causes and consequences of floods go beyond domestic and international borders makes coordination of state activities and those of the *Länder* essential. This is also recognized with regard to non-structural measures and preparedness. At present, ten centers are responsible for flood forecasting on the Elbe River: nine *Länder* institutions and one federal office (Bundesanstalt für Gewässerkunde 2002: 45). In addition, flood forecasts are made on a daily basis at the Flood Forecasting Center Elbe in Magdeburg using the forecasting system ELBA and data from further eleven gauge station at the Elbe, three at the Saale River, and one at the Havel River. Despite the fact that numerous gauge stations (namely: Seidewitz, Müglitz, Rote Weißeritz, Wilde Weißeritz, Vereinigte Weißeritz, Vereinigte Mulde, Freiberger Mulde, Bobritzsch, Striegis) at tributaries have been destroyed in 2002, flood forecasts were possible. This was important since the forecasts served as a planning basis for the emergency

operation centers. Figure 8 shows the flood forecasting system of the Elbe River drainage basin, including the gauge stations and their forecasting periods.

Figure 8: Flood forecasting in the Elbe River drainage basin



Source: modified after Bundesanstalt für Gewässerkunde (2002: 45)

2.2.2 Risk Financing

Risk financing measures, most notably insurance, are important instruments for spreading risk. Insurance can be a powerful means for motivating the insured to take loss reduction measures when premia or deductibles are tied to the level of mitigation undertaken by the insured. On the other hand, it may be hard to assess the level of mitigation undertaken and to structure contracts appropriately so there no disincentives are provided resulting in the reduction of risk-minimizing efforts after having bought insurance coverage (*moral hazard*).

As Table 8 illustrates, there are different types of institutional arrangements in flood insurance. In Germany, insurance against natural hazards such as floods, earthquakes and landslides is offered as a voluntary extension of property insurance and household contents insurance. Only cover against storm and fire is included by default in the insurance packages. In Eastern Germany, where before reunification household contents insurance used to cover all natural hazards, a major share of these policies are

continued. To compare, in the UK, for example, flood insurance is automatically "bundled" with residential property insurance, which is required as a condition for a home mortgage. Moreover, flood insurance demand in Germany is rather low: about 10% of households in Western Germany are insured against floods, and ca. 30-40% in Eastern Germany due to the continuation of all-hazard insurance contracts.

Table 8: Flood insurance scheme of selected countries

	Germany	United States	United Kingdom
Role of state government	No role	Primary insurer	No role
Type of flood insurance available	Private insurance available as extension of household policy	The National Flood Insurance Program (NFIP) insures household and commercial property	Only private; automatically included in homeowner's policies
Reinsurance for catastrophic losses	Private reinsurance	If premium reserves exhausted, NFIP borrows at market rate from treasury	Private reinsurance, capacity considered sufficient
Premium basis	Premium on risk basis	Partly on risk basis; high risks are subsidized through lower premium	Rates set according to post code risks; risk-based premiums avoiding adverse selection
Government compensation to insured and uninsured	Only in case of an extreme event	Yes	Only to uninsured who are in great need
Government compensation to local governments	Only in case of an extreme event	Up to 75% of infrastructure repair is statutory	Yes, but minimal amount

Source: modified after LINNEROTH-BAYER et al. (2001: 63)

From 1960 to 1994, the federal state of Baden-Württemberg was the only *Bundesland* that had mandatory insurance covering flood damage (and since 1971 earthquake damage) in addition to fire-, storm- and hail insurance. Since July 1994, the two state insurance companies have been converted into two competing common stock companies since, in accordance with Art. 3/33 of the third EU coordination guideline, all insurance monopolies – except for the social insurance monopoly – had to be abolished by 1995. Also important is the fact that in 1991 the *Bundesaufsichtsamt für das Versicherungswesen* (Federal Regulatory Authority for the Insurance Industry) permitted more extensive insurance covering elemental risks for residential buildings, household fixture, and business – without covering storm tide and backwater damage. While only few additional cover for all-hazard insurance had been sold after the introduction in

1991, the earthquake of Roermond in April 1992 has increased dramatically the demand for new insurance and stayed at a higher level ever since (see EIKENBERG 1998).

Furthermore, premia and deductibles are based on risk zones in Germany, whereas, for example, in the *National Flood Insurance Program* in the USA premia in high risk zones are partially subsidized by premia in lower risk areas, thus there are substantial cross-subsidies from persons in low-risk to persons in high-risk areas – a kind of solidarity through the private market (see Linnerooth-Bayer et al. 2001). Finally, in Germany, government compensation to the private sector and local governments is only foreseen for very extreme events.

Recently, the German insurance industry established a rating system that defines the exposure of all areas of the country to river floods according to three different exposure classes: (I) areas that are affected less than once per fifty years and objects that are insurable without restriction, (II) areas with floods in the recurrence interval range of ten to fifty with basically insurable objects, and (III) areas on flood plains that are affected by floods with recurrence interval range of up to ten years and with objects that are not insurable or only under certain conditions (see KRON & THUMERER 2002: 13). Moreover, Munich Re developed the world's first flood loss accumulation model for an entire country to carry out analyses of flood events occurring in Germany. In the probable maximum loss (PLM) analysis the values of liabilities of a given portfolio affected in one out of eight different accumulation scenarios are determined and the probable losses estimated for fictitious ten-year to two-hundred-year floods (2002: 14f).

Spreading disaster risk over all Germany is not likely to be feasible without mandatory insurance. After several attempts by some *Länder* to introduce a mandatory insurance or an all-German insurance-pool there were discussions about adopting the French model of semi-governmental insurance. However, nothing was ever realized. At the end of 1995, the *Arbeitskreis der Versicherungsaufsichtsbehörden der Länder* (Working Group for the Supervisory Authorities for the Insurance Industry) concluded that such a model was unconstitutional because it interfered with the principle of self-determination. Nevertheless, the Elbe floods have partly pushed new attempts and, for instance, the Free State of Saxony strongly supports the introduction of a mandatory disaster insurance on the European level (Sächsische Zeitung 2002: 1).

3 Damages and Losses

3.1 State/Federal Level

In the third week of August, official German sources issued damage estimates for Saxony of about € 15 billion (commerce: € 4-5 billion, private: € 3-4 billion, infrastructure: € 5-7 billion), for Saxony-Anhalt of € 5-8 billion, and Bavaria of € 0.5-1.5 billion. On August 28, 2002, overall damage was estimated to be € 20 billion (PRÜFER 2002). According to Swiss Re (2002), the insured loss was estimated to be substantially lower than the economic loss since flood insurance penetration is generally low and/or sublimited in the affected countries. In Germany, significant flood events in the past have led to insured shares of the economic loss of <10% in Bavaria (May 1999) and approximately 20% in East Germany (Oder, 1997), in which one out of two homeowners has flood insurance. Concerning the Elbe floods in 2002, Swiss Re's estimate of its loss exposure was approximately CHF 250 million.

With these estimated losses in mind, a special disaster relief and reconstruction fund – the so-called *Sonderfonds Aufbauhilfe* – was set up. In December 2002, the € 20 billion was consequently revised to € 9.068 billion. The amount of financing of the government fund was not significantly decreased. According to a press release from the Federal Ministry of Justice (Bundesministerium der Justiz 2002), Table 9 shows both the initial estimated (Die Welt 2002) and the original official estimate.

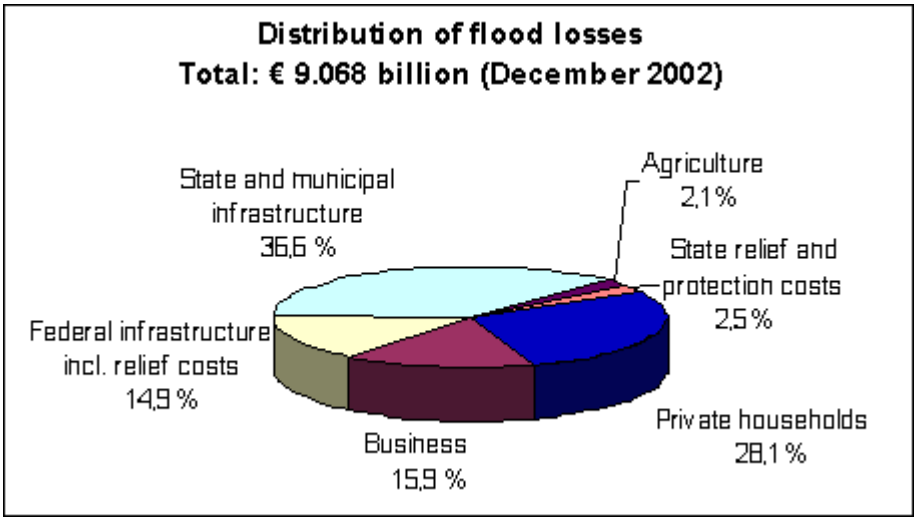
Table 9: 'November-estimate' and original official estimate of losses according to sector

Sector	Estimated Losses, 11/02	Official Losses, 12/02	
	in billion €	in billion €	% total
Länder and municipal infrastructure	2.2	3.316	36.6%
Private households	2.6	2.547	28.1%
Private companies	2.1	1.438	15.9%
Federal infrastructure incl. relief costs	2.0	1.353	14.9%
Länder relief and protection costs	-	0.223	2.5%
Agriculture	0.3	0.191	2.1%
Total	**9.2**	**9.068**	100.0%

Source: modified after Bundesministerium der Justiz (2002)

Figure 9 graphically shows the distribution of losses. The major share accrued to *Länder*- and municipally-owned infrastructure (36.6%). Private households suffered about € 2.6 billion of losses (28.1%), followed by private companies (15.9%). Losses to federal infrastructure including relief costs amounted to 14.9%, state relief and protection costs amounted to 2.5% and agriculture to 2.1%.

Figure 9: Distribution of direct losses



Source: modified after Bundesministerium der Justiz (2002)

Concerning the regional distribution of losses, Saxony was hit hardest. With direct damages of about € 6 billion the federal state bore 67% of the total losses. This value makes up ca. 40% of the annual Saxon government budget (interview with U. Kraus, December 10, 2002). About 14.9% of the overall damage was to federally owned infrastructure in the affected areas; 11.3% to the state of Saxony-Anhalt. The losses according to *Länder* are listed in Table 10.

About half of all losses from floods occur far away from major rivers and outside major events that hit large areas and whole river systems (KRON & THUMERER 2002: 12). Also in August 2002, a lot of damage was caused in small areas by tributaries of the Elbe River. In the case of Pirna, the city even suffered two floods: first from the tributary Gottleuba River, and then from the mainstream Elbe.

Table 10: Spatial distribution of flood losses

Federal State	Loss Ratio	Absolute (in €)
Saxony	67.0%	6.084 billion
Federal level	14.9%	1.353 billion
Saxony-Anhalt	11.3%	1.029 billion
Bavaria	2.2%	197.40 million
Lower Saxony	2.0%	174.29 million
Brandenburg	1.6%	144.65 million
Thuringia	0.5%	48.99 million
Mecklenburg-Western Pomerania	0.4%	32.91 million
Schleswig-Holstein	0.1%	4.22 million
Total	**100.0%**	**9.068 billion**

Source: Bundesministerium der Justiz (2002)

Focusing in on Saxony, losses were most severe in the region of Dresden, where ca. 47% of the losses occurred (see Table 11). Dresden and Pirna, the two municipalities examined, constitute 13% and 2% respectively of total losses in Saxony.

Table 11: Losses in Saxony according to districts

District	Absolute Losses (in million €)	Loss Ratio
Region Dresden	3.41	47%
of which Dresden	0.96	13%
of which Pirna	0.18	2%
Region Chemnitz	1.40	19%
Region Leipzig	1.28	18%

Source: Sächsische Staatsregierung (2002b)

3.2 Municipal Level

Given the higher damage potential in Saxony's capital, the highest losses occurred in Dresden where the floods caused € 400 million losses of public assets (see Table 12). Losses of private households were € 395 million (41% of total losses in Dresden) and losses of businesses € 67 million (17% of total losses). Many cultural landmarks were damaged, including the Semper Opera, the Zwinger Palace museum, and the train station. At the time when the interviews were conducted in December, Dresden had about 3,100 instances caused by the Elbe River or one of its tributaries. According to government officials, roughly twenty-five percent of the companies had flood insurance (interview with D. HILBERT, December 11, 2002).

Table 12: Losses in Dresden and Pirna according to sectors

	Dresden		Pirna	
Sector	Absolute Losses (in million €)	% Total	Replacement Costs (in million €)	% Total
Public assets	400	42%	32.600	18.0%
Private Households	395	41%	111.100	61.4%
Business	167	17%	37.200	20.6%
Total	**962**	**100%**	**180.900**	**100.0%**

Source: Mitteldeutscher Rundfunk (2003) and local government of Pirna, January 7, 2003

In Pirna, about fifteen percent of the total area had been damaged by the floods. The loss analysis carried out by the local government records on January 7, 2003, an overall damage of about € 181 million. The highest losses were suffered by residential buildings with ca. € 111 million in damages, which is about 61.4% of the total damage. Next are private firms with € 37 million losses (20.6%) of which private public infrastructure suffered damages of about € 10.3 million.

4 Financing of the losses

Already during the floods a variety of response measures took place, ranging from rescue and relief to humanitarian assistance from different governmental and nongovernmental actors. The general public also exhibited an enormous solidarity not only in collecting money but also in actively helping people affected by the floods (see Figure 10). Almost all interviewees pointed out the positive solidarity aspects during and after the flood.

Figure 10: Public solidarity at the Albertbrücke in Dresden

Source: Photo by Otto STELLMACHER

The pictures of the flood stricken Saxony prompted many people across Germany to donate generously for the affected residents. A few examples should illustrate the diversity of donors: for instance, state governor MILBRADT established a donation account for international transactions to support the victims of the flood disaster (see Figure 11). The German Red Cross Organization (DRK) initiated a project "Neighbors in Need – Flood 2002" and the German national soccer team decided to donate around € 500,000 to the flood victims. On August 16, a fund-raising gala in Burg sponsored by the public TV channel ARD and the newspaper "*Bild*" collected € 16 million. According to ARD, this was the largest donation total ever collected at a gala in German television history.

The media activity “Hamburg helps floods victims” of former chancellor Helmut SCHMIDT compounded nine newspapers and TV channels and collected almost € 13 million (FINK 2003). In total, about € 242,6 million was donated by the general public (interview with M. PRIESTERATH, December 10, 2002).

Figure 11: Saxony appeals for funds

Appeal for Funds
Saxony needs your help!

Saxony has experienced the worst floods in over one hundred years. Mountain regions experienced flash floods. The Elbe River has exceeded the highest water mark ever measured. More than 400 miles of roads have been damaged or destroyed. 180 bridges have been affected or destroyed. Thousands of Saxons have been made homeless. Over thirty thousand people had to evacuate their homes. Many historic monuments, rebuilt over more than a decade, are affected.The floods are just now beginning to recede. Hope is returning. Although much of our State, the majority of our people and the majority of our industrial base were unaffected by this disaster: rebuilding Saxony, helping the affected people reconstruct their homes and families, supporting the companies with flood damage, all of this will take a national, yes international effort.

Donations from across the world can help. Sending such help can make the difference. Supporting your Saxony customers and suppliers will be key to restoring our society's
well being.

We need your help. We will not be able to get back to normal l
ife without international help. We welcome your show of solidarity.
Below you will find information for how to send us help.

We depend on you!

Minister President Milbradt established a **donation account** for
international transactions to support the victims of the flood catastrophe:

Dresdner Bank Dresden (Germany)
Account No.: 040 551 2300
Bank Code: 850 800 00
Keyword: Flutkatastrophe (flood catastrophe)
Recipient: Freistaat Sachsen (Free State of Saxony)
SWIFT-BIC: DRES_DEFF / IBAN: DE88

Prof. Dr. Georg Milbradt
Minister President of Free State of Saxony

Further Informations: www.sachsen.de

Source: Sächsische Staatsregierung (2002c)
(URL: http://www.sachsen.de)

The high public solidarity has certainly influenced the *modus operandi* of governmental response measures, i.e. the reconstruction fund as an "externally-driven measure", and the set up of a special, independent commission as an "internally-driven measure". This so-called KIRCHBACH Commission (after General a.D. Hans-Peter KIRCHBACH who is well-known for his role in commanding the German troops during the River Odra floods in 1997) was set up to evaluate the response measures taken during the Elbe River floods as well as to elaborate and evaluate proposals for modern disaster protection structures. One important result of the assessment was a demonstrated shortcoming of the warning systems. Also the public administration and its communication structures were criticized. The KIRCHBACH-Report, 252 pages long and published in December 2002, contains information concerning flood prevention measures, disaster response, as well as proposals with regard to improving disaster protection including flood protection and flood early warning systems. The report is available in German at the web site of Saxony (http://www.sachsen.de).

4.1 Financing Sources

First, it should be mentioned that German federal states do not have the power to raise revenue or to set their own tax rates. Pursuant to the Basic Law (*Grundgesetz*), the *Länder* receive tax revenue under a system of apportionment, which entitles each *Bundesland* to collect certain federal state taxes *(Landessteuern)* directly within its territory. Examples of such taxes are: inheritance tax, property transfer tax, motor vehicle tax, and beer tax. The Federal Government is likewise entitled to certain other taxes on an exclusive basis (*Bundessteuern*) that are transferred to the Federal Government after having been collected by the States. Examples here are: capital transfer tax and insurance tax. At the same time, the Basic Law provides that the revenue generated by personal income tax, corporate income tax and sales tax belongs jointly to the Federal Government and the German *Länder* (*Gemeinschaftsteuern*).

The revenue generated from the *Gemeinschaftsteuern* is allocated among the Federal Republic and the individual federal states and their respective municipalities. The Basic Law provides that fifty percent of the revenue generated from the personal and corpo-

rate income taxes belong to the Federal Government and the other half to the federal states. Moreover, the *Länder* and the Federal Government are equally entitled to use the revenue arising from the sales tax to cover their necessary expenditures. Consistent with this principle, the sales tax revenue is first allocated vertically between the Federal Government and the federal states as a whole based on their respective projected expenditures. In 2001, 50.25% of the sales tax revenue generated during the year is allocated to the Federal Government, and the remaining 49.75% to the *Länder*. At least three-quarters of the *Länder* portion of the sales tax revenue is then distributed between the federal states based upon the size of each state's respective population. The remaining quarter is allocated among the financially weaker *Bundesländer*. This financial equalization for which tax revenue per capita is used as the metric – the so-called *Länderfinanzausgleich* – is an important element of the German federal system. Financial equalization is undertaken vertically and horizontally. Vertical equalization denotes the transfer of resources from higher levels of government to lower levels, horizontal equalization implies equalization among similar administrative levels (states, municipalities).

The Elbe floods were considered a case for national solidarity rather than individual responsibility or local solidarity. In the Elbe floods, the federal government, the states (*Länder)* and the European Union were willing to massively fund an unprecedented portion of damages. The declared will of the national government was that nobody should be worse off than before the floods. National solidarity was invoked and a special national disaster relief and reconstruction fund – the so-called *Sonderfonds Aufbauhilfe* – amounting to € 7.1 billion was created.

The *Aufbauhilfe*-fund was created by means of tax raises in all of Germany regulated by the *Fluthilfesolidaritätsgesetz*, a special flood help solidarity law decreeing:

- One year shift of planned decrease of income tax rate until 1.1.2004;
- Increase of corporate income tax of 1.5% percentage point to 26.5% for one year;
- Fund will be € 7.1 billion even if additional tax revenue falls short of this amount.

This large amount of government financing is unheard of for any other natural disaster in Germany since World War II; there were, however, several exceptional circumstances that need to be considered:

- Extreme event, largest losses ever in Germany: many hydrological records were broken and the floods are commonly referred to as the millennium floods (*Jahrtausendhochwasser*).
- The floods mainly affected East Germany that is still struggling economically and where unemployment is high. The general reconstruction of East Germany (*Aufbau Ost*) is considered an important long-term issue of national solidarity.
- Some observers cite the "hot" election phase. Federal elections were in their final stages of what was known to be a very close election.

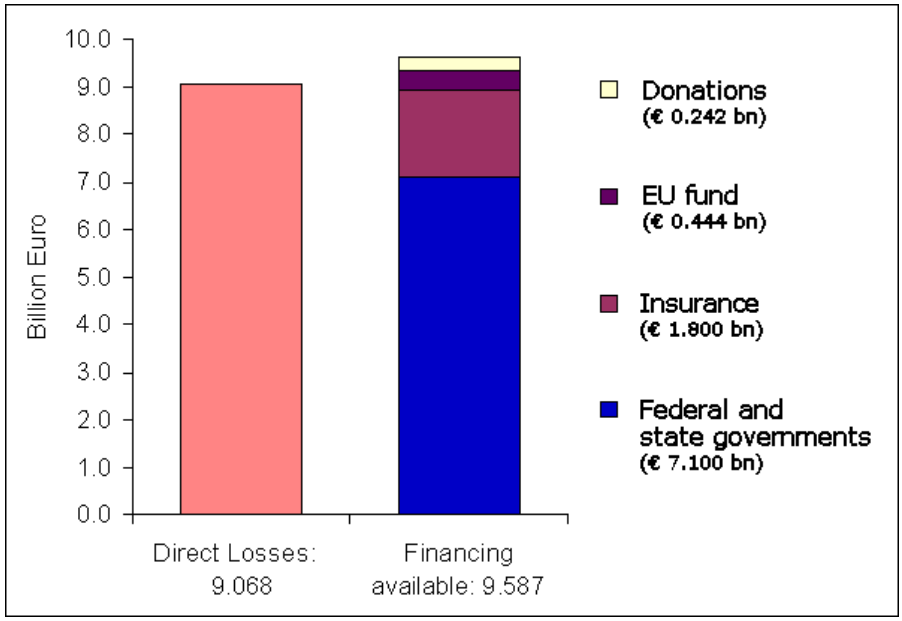
Additionally, financing came from the following sources (see Figure 12):

- EU solidarity fund: an EU solidarity fund for emergencies was newly created with an annual amount of € 1 billion. Parts will be available already in 2002. In total, it € 444 millions were transferred to reconstruction financing in the affected German areas (Bundesministerium der Justiz 2002). This fund will be used in the future to also fund other complex emergencies, like e.g. oil spills.
- Private donations amounted to € 243 million (Interview with M. PRIESTERATH, December 10, 2002).
- Insurance indemnity payments are estimated to sum up to € 1.8 billion (Munich Re 2003), which is approximate 20% of total losses. In Germany, penetration of flood insurance bought by private households as an extension to their households contents or property insurance is low (ca. 10%), however, in East Germany, former insurance policies, that did include disaster coverage, were continued after the reunification, thus penetration is higher at about 30-40%. About 25% of affected businesses had purchased insurance.

Estimating the availability of all these sources, in total € 9.6 billion can be expected to be available thus exceeding the losses of € 9.1 billion. Considering that government compensation will be provided in terms of replacement costs rather than current value

lost, still all direct losses could be compensated, in theory. However, as explained later, it was generally not planned to compensate losses 100%, so some of the money set aside by the government for compensation will probably flow back to the budget.

Figure 12: Losses and financing sources

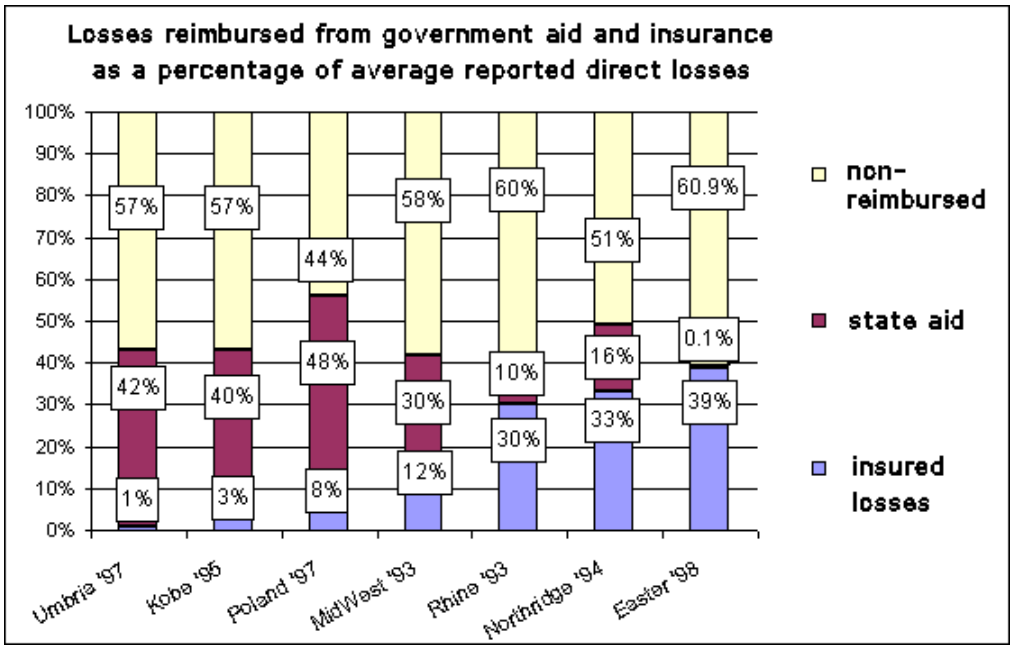


Source: Staatskanzlei Freistaat Sachsen (2002), Munich Re (2003), Interview PRIESTERATH

Compared to total compensation provided in other major events in developed countries, which on average amounted to 45% of total losses (Linneroth-Bayer at al. 2001),[1] this large financing provided is exceptional. Figure 13 shows the amounts compensated by insurance and state aid and the uncompensated amounts for these events in terms of total average reported direct losses across 7 earthquakes and flood events in the 1990's. As illustrated, the financial aid provided in 2002 was also exceptional for German standards. For instance, in the 1993 River Rhine floods considered an event with a return period in the range of 100 years and causing direct damages in excess of € 550 million, state aid amounted to 10% and about 60% of the losses remained uncompensated (Linneroth-Bayer et al. (2001: 19). Possible explanations are

the upcoming elections for the German Bundestag, the extreme magnitude of the flood event, and the geographical location.

Figure 13: Loss compensation in 7 severe natural disasters



Source: LINNEROOTH-BAYER et al. (2001: 48)

The sectoral distribution of financing was broadly similar to the losses incurred in the respective sectors. In general the fraction of losses financed was higher for reconstruction than for private households and businesses in order not to provide adverse incentives for the private sector. This does not mean that all direct losses will be covered by this financing ratio. For instance, the financing ratios specified in the *Sonderfonds Aufbauhilfe* differ for the affected sectors as will be explained further below.

The regional distribution of financing corresponds to the distribution of losses. In Table 13, also financing going to the reconstruction of federal assets is included which

[1] These events were the Rhine floods in 1993 and 1995 in Germany, the Midwest floods in the USA 1993, the Northridge earthquake in 1994 in the USA, the Kobe earthquake in 1995, the Umbria earthquake in 1997, the 1997 floods in Poland and the Easter floods in 1998 in the UK.

explains that the financing ratios are higher than the loss ratios in Table 10. The major share of financing is and will be distributed to Saxony.

Table 13: Distribution of reconstruction fund (*Sonderfonds Aufbauhilfe*)

Federal State	Loss Ratio
Saxony	78.85%
Saxony-Anhalt	13.34%
Bavaria	2.56%
Lower Saxony	2.26%
Brandenburg	1.87%
Thuringia	0.64%
Mecklenburg-Western Pomerania	0.43%
Schleswig-Holstein	0.05%

Source: Bundesministerium der Justiz (2002)

4.2 Principles Used in Loss Financing

Providing relief and loss compensation is an obligation of government; however, it also raises important questions about equity, efficiency and the provision and maintenance of incentives for ex-ante mitigation and risk-financing measures. In the Elbe floods case, several principles were put forward and used by the government authorities for the financing of the losses (Staatskanzlei Freistaat Sachsen 2002) in order to guarantee the efficient allocation of the funds, allow quick reconstruction and provide and keep incentives for ex-ante measures.

Subsidiarity: The principle of subsidiarity (*Subsidaritätsprinzip*) is constitutive for the federalist structure of Germany and denotes the delegation of responsibilities to the lowest administrative level feasible. The principle of subsidiarity was followed in the financing of losses. A core element of the publicly financed assistance was the reconstruction of infrastructure owned by municipalities, which constitutes the major part of public infrastructure. The *Subsidaritätsprinzip* was used insofar as decisions about reconstruction were delegated to the municipalities:

- Municipalities had to elaborate plans for reconstruction and determine priorities.
- Compensation fraction was high: minimum 90%, sometimes even up to 100% were planned to be reimbursed (the process is still ongoing).
- Municipalities could exceed maximum of allocated limits in order to quickly and sufficiently rebuild.

Furthermore, immediately after the event, the local authorities were given money to provide private households with emergency relief funds.

Parallelity: Reconstruction in Saxony was and is to run parallel and independent of *Aufbau Ost* (reconstruction in East Germany); no financing from *Aufbau Ost* was to be diverted for flood losses in order not to hamper the general reconstruction. This division of funding is also used for matters of bookkeeping, where budgets are kept separate.

Incentives: It was generally emphasized that the government is not the "insurer of last resort." The Elbe floods were considered an exceptional event this time, but in general the population should take appropriate prevention and risk financing measures. In order to provide incentives, deductibles were included when distributing state or federal help (i.e. full compensation was usually not granted). Also, in case of an existing insurance protection, attention was paid to avoiding overcompensation when providing financial assistance. Thus, incentives for mitigation and insurance were maintained.

Efficiency: Losses were defined rather narrowly in order to compensate efficiently and ensure that assistance was sufficient for financing the direct losses in the localities that were affected strongest. The following issues were brought forward:

- Financing should be done for direct losses only, as financing indirect losses also may exceed financial ability and it was felt that these losses could not be be estimated with precision. It was feared, that else other states that were not affected as strongly or more indirectly by increased precipitation would use those funds.
- Financing of losses only that arose from 10th August to 30th August during flooding of Elbe and its direct and indirect feeder rivers.
- Smaller losses due to heavy precipitation were not to be financed by money from federal/state program.

Focus on ability to rebuild: Loss financing was provided in terms of reconstruction costs rather than current value. In effect this means higher loss compensation than if current values had been used, and allows to rebuild according to the current state of technology thus improving conditions.

A general problem with financing was that the total amount of the *Sonderfonds Aufbauhilfe* was determined before losses were fully clear. After downward revision of losses, some states were intent on broadening the definition of losses to be reimbursed in order to deplete the fund for their purposes. They argued in favor of including indirect damages like business interruption losses in order to increase the fraction of losses compensated.

The financing measures fall into two phases (see Table 14):

- First phase: emergency relief. Unbureaucratic, quick help was provided.
- Second phase: reconstruction assistance, "differentiated loss compensation". More rules were employed and a more careful evaluation was undertaken in order to allocate money to greatest needs. Generally, a deductible was included to guarantee the efficient allocation of money.

Table 14: Financing programs

Emergency Relief Financing	Private Households	Residential Property	Business	Agriculture & Forestry
	500 €/person, max. 2000 €/household	5,000 €/building	15,000 € (50% of loss) and 500 €/employee	50,000 €
Reconstruction Financing Assistance	**Municipal Infrastructure**	**Residential Property**	**Business**	**Agriculture & Forestry**
	90% of reconstruction costs	Max. 80% of reconstruction costs	35-75% of reconstruction costs	Max. 30% of crop losses, max. € 1 million

Source: Staatskanzlei Freistaat Sachsen (2002)

What concerns the reconstruction program, for which the major part of the *Sonderfonds Aufbauhilfe* money will be disbursed, generally full compensation was not planned. The highest compensation ratio was foreseen for the infrastructure sector with funding for 90% of the losses, for private households a maximum of 80% of losses to be

financed were foreseen, for private business this ratio was set at 75% as a maximum. Also, insurance disbursements were regulated to be counted in order to prevent overcompensation. The intention in using deductibles was to provide incentive for the future to engage in loss prevention and financing measures and guarantee the efficient use of the provided funds, which was felt would occur if a portion had to be provided by the affected themselves.

Major aims in devising these measures were to repair buildings and institutions as quickly as possible and prepare at least for the winter and help the economy to recoup as quickly as possible. In total, it is planned to finish the major part of reconstruction by the end of 2004, i.e. 18 month after the floods.

These measures had to balance conflicting objectives between necessary fast assistance and the level of care derived from state and municipal laws and regulation to ensure the efficient and transparent assistance meeting the needs of those affected.

What is interesting to note is that by December, only ca. 2,000 claims from private households had been filed in all affected areas in Germany, whereas the total number of affected was estimated at 10,000 households. Thus, sufficient funds were still available in the *Sonderfonds Aufbauhilfe* for compensating private households.

4.3 Loss Financing on Municipal Level

As shown in Table 15, both Dresden and Pirna suffered high losses in absolute terms and when compared to annual budgets.

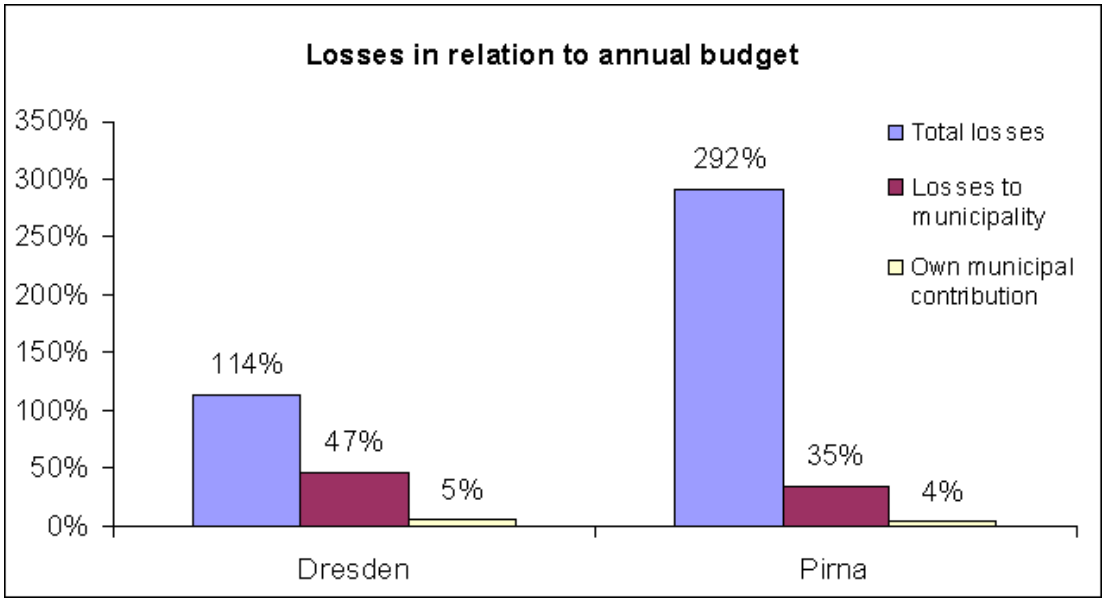
Table 15: Losses in Dresden and Pirna in comparison

	Dresden		Pirna	
	in million €	% of budget 2002	in million €	% of budget 2002
Total losses	962.0	114%	181.0	292%
Losses to municipality	400.0	47%	22.0	35%
Budget 2002	847.0	-	62.0	-
Expected own municipal contribution (10% of losses)	40.0	5%	2.2	4%

Sources: Local governments of Dresden and Pirna, MDR (2003)

In Dresden, total losses in all sectors as a ratio of the budget amounted to 114%, in Pirna even 292%. Losses to municipal infrastructure amounted to 47% respectively 35% of the budgets in Dresden and Pirna. City officials in both cities asserted that it would have been impossible to finance these losses, let alone compensate private households or firms (see Figure 12).

Figure 14: Losses in Dresden and Pirna compared to municipal budgets



Sources: Interviews with U. KRAUS and I. HUMAN

The municipalities expect to receive 90% of their losses in the currently ongoing negotiations from the *Sonderfonds Aufbauhilfe.* Thus, Dresden and Pirna will only have to finance ca. 5% respectively 4% of their losses themselves. Additionally, these fractions will probably decrease, as donations and in the case of Pirna insurance indemnity payments will come forward (these amounts were as of the time of writing not disclosed).

Due to declining income from corporation tax revenue in the last few years, both cities are heavily constrained in their financial means. City officials stated that they would not have been able to finance these losses. Therefore, aid from the *Sonderfonds Aufbauhilfe* was welcome.

In Dresden, as demanded by Saxon state law, it was planned for the hundred-year flood event. Analyses and regulations existed for such events, but consequently, for rarer events no maps existed and an event of this magnitude was generally not expected. The city lost € 400 million mostly in municipal infrastructure. Although the deliberations about loss financing are not finished, Dresden expects to receive 90% of its losses to be paid out from 2002-2006 with 50% to be disbursed in 2002/2003. Dresden was not insured. Accordingly, € 40 million have to be provided by mainly by budget diversion (possibly also to small degree by private donations), which according to city officials will be painful. However, the floods and the impacts on the budget were not mentioned in the budget proposal for 2003 indicating that extra costs can be financed. Generally, city officials asserted that financing € 400 million by own means would have never been possible for Dresden and considered solidarity financing the right approach for the Elbe floods and similar future events of this magnitude.

The municipality did not finance losses of private households and business, but disbursed relief money to private households and business that it received from the *Sonderfonds Aufbauhilfe*. It is estimated that ca. 25% of private businesses in Dresden were insured. 3,100 cases were noted in this sector with 22,000 employees affected.

For the future, a number of measures relating to flood protection and prevention are planned. These will have to be financed in addition to the city's loss element. This will be difficult as there generally is competition for other projects. This was described by a city official during an interview with the statement "The issue is whether to finance the opera house or undertake flood measures?"

Prevention measures planned for the future include

- Maps will be produced for rarer than 100-year events;
- Risk classes will be determined, which will be used to inform potential dwellers;
- Improvement of flood prediction;
- Improvement of contact to upstream Czech authorities;
- Improvement of coordination with state authorities.

In total, the municipality of Dresden sees its role as providing citizens with the information necessary to act most sensibly before and during floods. It was argued against using regulation e.g. for compulsory insurance by private households. Private citizens are considered hardly able to finance protection or ex-ante financing measures themselves due to low accumulated savings, which is typical of the East German economy and the private sector. Furthermore, it was mentioned by the city officials that one problem with risk zoning is that such a measure could have negative effects on the economy. For those planning to build in higher-risk areas marked accordingly as high-risk zones, the ability to take out loans or insurance will be severely affected. This could negatively influence larger companies decision, which in Dresden are mostly sub-sidiaries of Western German companies, to come to Dresden or to stay on.

With regard to Pirna, the city's losses to municipal assets and infrastructure amounted to € 22 million, of which Pirna expects, like Dresden, to have to contribute ca. 10%, € 2.2 million. In contrast to Dresden municipal assets in Pirna were insured to a certain degree. This was felt necessary due to the high risk exposure of Pirna. In 1997, Pirna had purchased a so-called *Elementarschadenversicherung* (all-hazard insurance) covering damage caused by different natural hazards, such as, earthquakes, landslides, avalanches, and floods. According to the city government, the insurance premiums have amounted to € 214,000 since 1997 and € 39,500 in 2002 (interview with I. HUMAN, December 11, 2002).

With regard to the Elbe River floods, the majority of the municipal buildings losses (without fixture) were insured, and also the loss of rent and recovery costs were compensated; deductible was one percent of the insurance sum. Since the insurance cover ended on December 31, 2002, the city government arranged a European-wide public call for insurance cover. Although it is not clear whether a new carrier can be found, it is, however, certain that the new cover would be more expensive.

The amount of insurance indemnity that will be provided is still unclear. This amount will be calculated in into the sum to be received from the *Sonderfonds Aufbauhilfe*, thus overcompensation will not occur. In addition to insurance, own contributions will be financed by budget diversion and donations. Additionally, the insurance provider cancelled the contract after the floods. Pirna is intent on getting coverage again.

Similarly as in Dresden, an extreme event like the Elbe floods was never foreseen. As demanded by state law, it was planned for the hundred-year flood, for which analyses existed. As in Dresden, Pirna officials asserted that they would not have been able to finance private sector losses. About 20% of private households are estimated to have carried insurance, how much will be reimbursed by insurance is as of today still unclear. Additionally, city officials found it necessary that full compensation of private households and businesses is not done, but rather that deductibles for incentives are kept. Solidarity financing as done for the floods was considered very important and officials were grateful for the support granted.

Concerning risk and disaster management, Pirna sees this obligation to lie with the district administration (*Kreisverwaltung*) as Pirna, unlike Dresden, is not an independent city, and is part of a district, which is the responsible administrative body for disaster management. Pirna officials see the need to closer cooperate with this administration.

5 Conclusion

In August 2002, floods in central Europe caused damage in the range of € 15 billion; insured losses were about € 3billion. According to Munich Re, this event was the most expensive disaster of the year 2002 in terms of economic losses. The greatest losses occurred in Germany where heavy rains led to some of the worst flooding the Free State of Saxony has witnessed in more than a century. On August 13, the Elbe River rose from a normal summer level of about two meters to reach on August 17, 2002, a water level of 9.40 m – the highest level that has ever been recorded in Dresden. From a hydrological perspective, thus, the Elbe River floods are an extreme event.

The Elbe River floods caused about € 9 billion of direct losses in Germany. Concerning the regional distribution of losses, Saxony was hit hardest with a damage of € 6.084 billion. About 14.9% (€ 1.353 billion) of the overall damage was to federally owned infrastructure and 11.3% (€ 1.029 billion) to the state of Saxony-Anhalt.

The major share of about € 4.790 billion accrued to federal state and municipal infrastructure (64.7%). Private households suffered about € 2.547 billion of losses (28.1%), followed by private companies with € 1.438 billion (15.9%), relief provided by the state governments amounted to € 223 (2.5%), and agriculture with € 191million (2.1%).

The event was considered a case for national and international solidarity: Estimating the availability of all the financing sources, in total € 9.6 billion can be expected to be available thus exceeding the losses of € 9.1 billion. Considering that government compensation will be provided in terms of reconstruction costs rather than current value lost, still all direct losses could be compensated in theory. However, it was generally not planned to compensate losses 100%, so some of the money set aside by the government for compensation will probably flow back to the budget.

The major part of the financing was provided by a special disaster relief and reconstruction fund – the *Sonderfonds Aufbauhilfe* – created by the federal and state governments of Germany. The fund amounted to € 7.1 billion, 78% of total direct losses. Other sources of financing were a newly created EU fund (€ 444 million), insurance (estimated to amount to € 1.800 billion) and private donations (€ 244 million).

The size of the *Sonderfonds Aufbauhilfe* was determined after early rough estimates and the total amount of financing made available was not adapted after losses were revised downward by ca. 50%. This had the effect that some states were intent on receiving additional money from the fund, e.g. for precipitation events rather than flood damages. Since public money was available, the state of Saxony-Anhalt, for instance, argued for expanding the definition of flood damage, i.e. also indirect losses and losses caused by precipitation and rising groundwater should be compensated. Finally, this argumentation was not followed, and only direct losses were considered for compensation.

The provision of government funds to the affected private households, companies and municipalities was and is governed by a set of principles in order to guarantee the efficient and fair allocation of the funds, allow quick reconstruction and provide incentives for ex-ante measures. These principles included *subsidiarity* (the delegation of responsibilities to the lowest administrative level feasible), *parallelity* (reconstruction in the affected East German region was and is to run parallel and independent of the reconstruction in East Germany after reunification), *provision of incentives* (inclusion of deductibles in order to maintain incentives for mitigation and insurance), *efficiency* (financing of direct losses only to primarily compensate those affected worst), and the focus on the *ability* to rebuild (loss financing was provided in terms of reconstruction costs rather than current values).

There were two phases for the funding from the *Sonderfonds Aufbauhilfe*:

- First phase where emergency relief was unbureaucratically and quickly distributed to affected people.
- In the still ongoing second phase, reconstruction assistance was and is provided. Here, more rules and a more careful evaluation of claims was/is undertaken in order to allocate money efficiently to greatest needs. Generally, deductibles were included for this financing in order to guarantee the efficient allocation of money.

Financing on the municipal level for two cities in Saxony was examined: Dresden, the capital of Saxony, and Pirna, a smaller city. These two cities experienced large damages to their infrastructure and public assets. Dresden € 400 million, equaling 47% of the budget of 2002, Pirna € 22 million or 35% of the budget. The two cities expect to

be reimbursed 90% of their damages in the currently ongoing financing provided by the national fund. The remaining amounts, they will pay by private donations and budget diversion. In addition, Pirna had purchased insurance and expects indemnity payments from this source.

Also, large losses suffered by private households and businesses in Dresden and Pirna, these losses will not be financed by the two municipalities. Again, financing for these losses is to a large degree coming from the government fund. Households can expect to receive 80% of their losses, businesses up to 75% from this fund.

Municipalities feel that losses caused by extreme events like the Elbe River floods need to be financed through national and international solidarity (i.e. taxes), though Pirna, a smaller city facing a high flood risk has undertaken some insurance of its assets. The municipalities see their roles as assessing the risk and providing warnings in time, not as compensating flood victims. This is a common view today, as corporation tax revenue in municipalities is decreasing.

When assessing a disaster event such as the Elbe River floods, it is necessary to take into consideration the context in which the event is embedded. For instance, the frequency of the hazard is of importance with regard to the flooding in 2002. State and local authorities in Saxony and Elbe regions by regulation have to plan for hundred-year floods – which was done. However, setting up flood protection for higher water levels is economically not feasible. Given the low probability of disaster occurrence in any local community over the short run, measures aimed at increasing prevention and preparedness are hardly cost effective in Germany.

Since disaster mitigation measures in Germany cannot fully prevent losses from very extreme events, the public expects the federal government to be politically and financially accountable for disaster management, in particular response and recovery. The federal government for its part responds to these pressures by reemphasizing responsibility for disaster management on local and *Länder* level as well as by legislatively increasing the variety and scope of individual assistance. The current emphasis on individual responsibility reflects the federal government's reduction of financial and legal responsibilities in disaster protection. Hence, there are political cross-pressures of simultaneously pursuing disaster management and political responsiveness: appropriate

policy response should focus on long-term support for prevention and preparedness – actual policy response focuses on response and recovery.

Another important issue concerning the loss compensation was the national elections. Though the federal states are responsible for disaster protection, politicians of the national government were extremely sensitive to the proximity of elections and their chances for reelection. Since in Germany a new government was to be elected about a month after the Elbe River floods, many politicians reacted to media reports about the large scope of the disaster. Analysts generally agree that the floods boosted the government's standing in the polls in the run-up to the general elections that took place shortly after the flood event.

The high solidarity of the public was a central characteristic of the Elbe River floods, both concerning financial donations and active support. In East Germany, as in West Germany, people have settled in traditional flood plains over the past decades to accommodate private and commercial buildings. This has led to an increased accumulation of economic values in flood prone areas – and may lead to a decrease in solidarity in the future. In the case of Röderau-Süd, a small community located in a flood plain area will be relocated – a flood prevention measure which is quite rare in Germany.

Already in 1996, a study "Deficits in disaster mitigation in industrialized countries – using Germany as an example" of the German IDNDR-Committee (see DOMBROWSKY & BRAUNER 1996) has indicated severe shortcomings in German disaster precaution. Among others, the lack of financing the siren warning system, or a lack of coordination, education and self-help measures was mentioned. Likewise, the KIRCHBACH-*Report*, the result of an investigation conducted by an independent commission, identified shortcomings in communication structures and flood protection. The commissioning of such studies and the formation of commissions are positive signals since disasters, by their very nature, require the participation of multiple actors, whose legitimacy is derived from alternative authority sources. Hence, coordination will become more important for mitigation, risk transfer and response activities, but also more problematic due to the increased potential for more severe disasters and an increasing number of participating actors.

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Appendix 2: List of Tables

Appendix 3: List of Interviewees

Mrs. Beate Bartsch (Saxon Bank of Reconstruction, Press Adviser)	Dec. 12, 2002 9:15 AM
Mr. Burkhard Beyer (Saxon Government, Press Adviser)	Dec. 10, 2002 4:45 PM
Dipl.-Ing. Bruno Büchele (Institute of Water Management, University Karlsruhe)	Jan. 9, 2003 written
Dipl.-Ing. Martin Gocht (Institute of Geoecology, University Potsdam)	Jan. 20, 2003 written
Mr. Dirk Hilbert (Dresden, Mayor)	Dec. 11, 2002 8:45 AM
Mrs. Inge Human (Pirna, Mayor)	Dec. 11, 2002 11:30 AM
Mr. Peter Kammel (Pirna, Head of the Fire-Brigade)	Dec. 11, 2002 11:30 AM
Dr. Christian Korndörfer (Dresden, Head of Department of Environment)	Dec. 11, 2002 8:45 AM
Hr. Ulrich Kraus (Saxon Government, Dep. Head of the Coordination Center 'Reconstruction')	Dec. 10, 2002 4:45 PM
Dipl.-Met. Armin Mathes (WeatherOnline, Bonn)	Feb. 3, 2003 written
Mrs. Birgit Monßen (Dresden, Head of Department of Economic Support)	Dec. 11, 2002 8:45 AM
Mr. Markus Priesterath (Federal Ministry of the Interior, Task Force ‘Flood Assistance')	Dec. 10, 2002 9:00 AM
Dr. Jochen Frh. v. Seckendorff (Saxon Bank of Reconstruction, Chairman of the Board)	Dec. 12, 2002 9:15 AM
Mr. Steffen Wehner (Pirna, Head of the Coordination Center ‘Elbe Floods')	Dec. 11, 2002 11:30 AM