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Effective disasters: 2013 European flood damage as a policy driver

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ABSTRACT

Disasters are the most tangible representation of climate change in our time. For policymakers, the easiest way to engage their constituents on new public policy is to relate it to a specific need. Natural disasters are an easily visible reference to remind people of a very pressing need for new disaster policy. Are frequent references to disasters then a motivation for policy change? If yes, do policy changes coincide with the degree of disaster damage? To compare policy responses to disasters it requires holding the magnitude of a disaster as a constant so as to compare the difference in policy action in relation to the same disaster. This assessment compares policy responses by nine (9) European countries (including; Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia) affected by the 2013 flood of the Danube, Elbe, and Rhine rivers. Life years are implemented to compare the disaster impacts across multiple situations (Noy, 2015). The expectation was that the country most impacted would have the most incentive and therefore apply the most elaborate disaster policy in response.

Keywords: *Keywords: Disaster; Policy; Flood; Europe; Policy Change; Policy Drivers; Life years.*

1. INTRODUCTION

Studies of policy change in the United States show disasters as focusing events in terms of new policy adoption (Birkland, 2004; Birkland, 2006). The question is whether this stands internationally and whether there is a threshold for how severe a disaster has to be before disaster policy is altered to incorporate lessons learned. The hypothesis is that a country that is more severely impacted by an accident would have more incentive and therefore pass changes to disaster policy following a significant event.

To look at this situation, in particular, a single disaster was required that was considered to be major climatologically, affecting multiple countries, and also not too recent to allow time. For policy changes, but not too long ago as to no longer be relevant. From these criteria, the Danube/Rhine/Elbe Rivers flood of 2013 was the best fit with the most data available. This disaster is considered the 7th most severe flood in the world from 1900-2016 in measurements of economic damage and largely impacted nine countries over one month (EM-DAT, 2017). This case also provides the exciting aspect of having eight of the nine involved countries being a part of the broader European Union community, with one completing the joining process within a month of the flood (CIA, 2017).

A comparison technique to include impacts from disaster across income levels was used to most accurately show non-monetary damages for each country equally. This measure of Life years (Noy, 2015) is based on the World Health Organization's Disability Adjusted Life Years to measure all damage in terms of human life instead of casualties or economic loss, which can both depend on individual qualities of the country (Noy, 2015). In countries with high incomes and high living standards, there is more expensive infrastructure, and even a little damage can cost a lot more than a levelled city in a country with fewer economic resources. Countries with high population densities will be more affected by a disaster in any given area but by raw numbers. There are other ways to measure disaster damage, for example, by the number of households or amount of agricultural damage, but all of these have a bias for different situations. Here, Life years are used to incorporate multiple types of disaster damage and reduce bias between countries at separate income or population levels (Noy, 2015).

National disaster policy has a long history of case studies observing action following a single disaster. The government is about to take responsibility for work when pushed by the public, but that only happens after the event, not proactively in any case (Birkland, 2004). Failure of the Tous dam in Spain in 1982 prompted a change from a focus on post-disaster aid and small-scale flood controls to mitigation techniques and improved preparedness (Serra-Llobet, 2013). Italian landslides have the same indicators as disasters that open policy windows, but these particular disasters have been noted not to necessarily cause policy change as standalone events (Scolobig, 2014). These are examples of an individual nation's response to a single event with limited comparative value to other situations.

1.1 Disaster Overview

While inland flooding is one of the most common natural disasters, the meteorological conditions of the 2013 European flood were rare but very similar to the significant 2002 and 2005 floods in the same region (Grams, 2014; Breinl, 2015). The flood occurred from May 28 to June 18th with the effects of lingering floodwaters lasting much longer, in some cases years (EM-DAT, 2017; Liska, 2014). The weeks before the flood was already cold and wet, saturating the ground. Fresh air was trapped over the Alps, and warmer air was stalled north, causing three consecutive cyclones moving westward and created a northerly flow against the west-east mountains, which created orographic enhancement of an already massive precipitation event. This 'warm conveyor belt' process in that direction is an infrequent situation but has "high potential for triggering very severe heavy precipitation events" (Grams, 2014).

Significant floods have become more frequent in the Danube River Basin over time (Bloschl, 2013). Significant flood event records go back to the 1700s, but the more recent events were in 1954, 2002, and 2005 (Bloschl, 2013). Many of the areas affected by the 2013 flood are the same that were hit by the 2002 flood which is known to have already instigated policy changes (JBA, 2014; Bloschl, 2013). In some areas, flood protection methods had been implemented following the flood of 2002. These avoided some of the damages in 2013 that would have occurred without those preventative measures. Most of those measures were in terms of natural levees rather than citizen education and preparedness (JBA, 2014; Bloschl, 2013). Damage evaluations of the entire flood showed the effects of the 2013 wave in Austria, Czech Republic, and Germany, at the same magnitude level of previous significant floods in 1954 and 2002, even after the implemented risk management programs over time (Fewtrell, 2013). For comparison at earlier waves, Passau, Germany, experienced flood levels similar to the highest recorded flood ever from 1501 (Bloschl, 2013). The flood magnitude was measured in different locations as anywhere between a 50-year flood to a 1000-year wave (ZIC, 2014).

1.2 Geographic Context

The geography of Austria is mostly mountains with the Danube flowing through. The majority of the population lives in the North eastern region of the country, because of poor soils and steep slopes most elsewhere (CIA, 2017). The Danube basin covers 96% of Austria, save a tiny portion of the western mountains; Austria covers 10% of the entire Danube basin (Gascoigne, 2009). Austria does receive high rainfall amounts in the Alpine mountainous regions, but much lower precipitation rates are recorded in the Northeast (ICPDR, 2006a). The Danube is used for hydroelectric power, amounting to 33% of Austria's total electricity, and is widely used for transportation of goods and drinking water.

The Danube River Basin covers almost half of the country and has 46% of the Bulgarian population residing within the basin (Gascoigne, 2009; ICPDR, 2017). The river also has regularly flooded; with virtually all of the open valley being used for urban infrastructure or agriculture. There is minimal water storage capacity surrounding the river (ICPDR, 2006a).

Most of the population of Croatia live in the northern half of the country with a quarter in the capital of Zagreb and the surrounding area (CIA, 2017). The Danube river makes up the far easternmost boundary between Croatia and Serbia as it flows southward from Hungary. The Danube basin covers 63% of Croatia, most of the northern and central portion, and 69% of the population (Gascoigne, 2009). The Danube is a major transportation route for international trade in Croatia and provides most of the drinking water for the country. Croatia does have generally more full preserved floodplains than most of their neighbours, but 15% of the mainland is still at regular risk for flooding (ICPDR, 2010).

The Elbe River Basin covers most of the country, and the Elbe itself goes through the capital city of Prague. Most of the previous flood policy has been centred on the Morava River after severe flood events in 1997 and 2002 (ICPDR, 2007a).

The southern German border is made by the Rhine River and the southern portion of the country, including Bavaria, has the Danube running through it (ICPDR, 2007b). The Danube River Basin only covers 17% of Germany, but Germany has the third-largest population residing in the Danube River Basin at 9.4 million people, behind only Romania and Hungary (Gascoigne, 2009). Flooding is the most common natural hazard for which Germany has to plan. With this substantial flood risk, Germany has taken many steps to develop flood prediction technologies and flood control measures (ICPDR, 2007b; CIA, 2017).

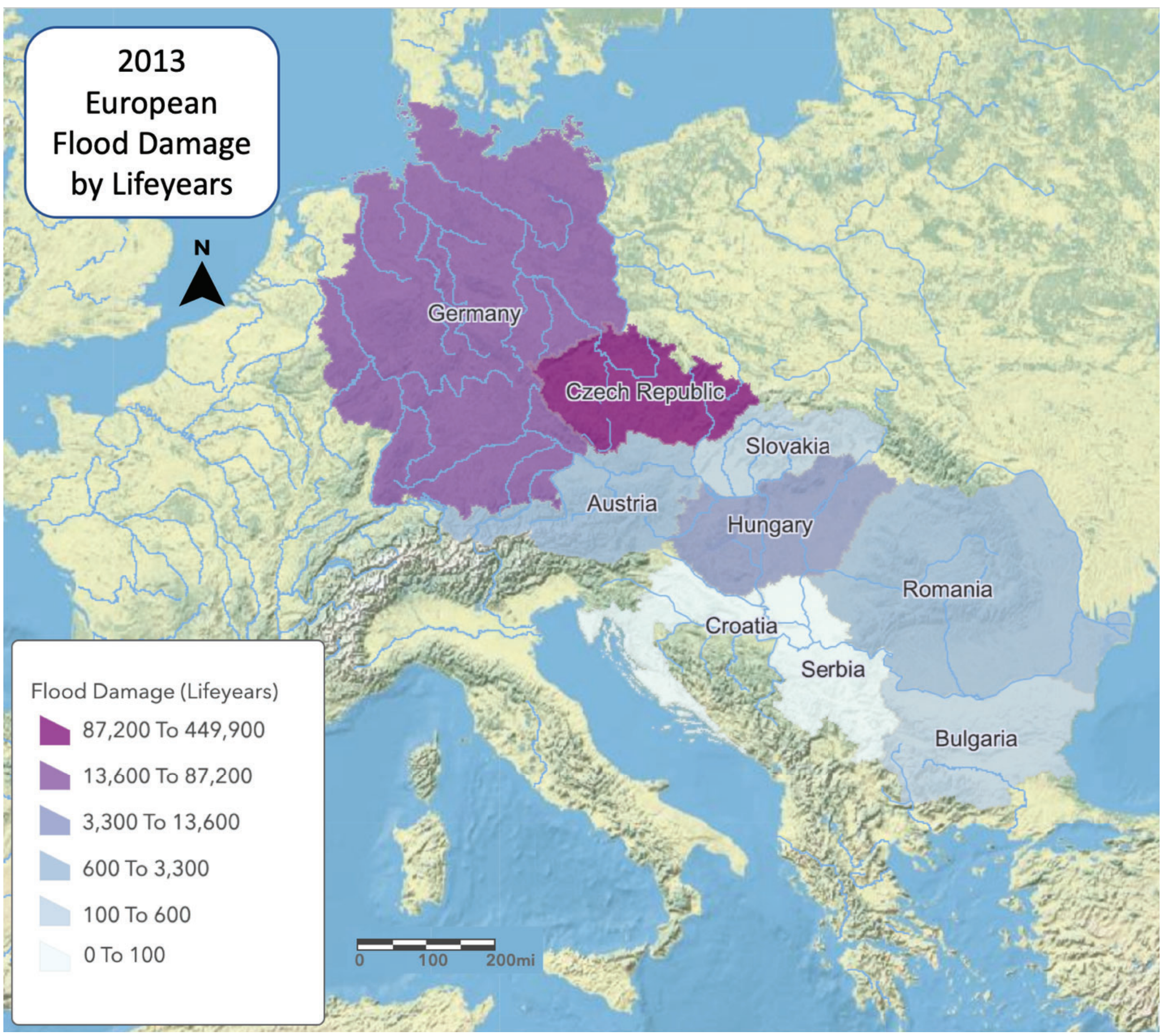
Hungary's entire population, 10.1 million people live in the Danube River Basin and the capital city of Budapest is directly on the Danube itself (ICPDR, 2006b). The Danube River Basin covers the entire country and Hungary contains the second-highest percentage of the total area of the basin for a single country at 11.6% (Gascoigne, 2009). A quarter of Hungary's population lives in a floodplain, along with a third of the rail system. Floods in Hungary have been known to last anywhere from hours to months. Because of this threat, they have developed flood protection systems consisting of emergency lowland flood reservoirs (ICPDR, 2006b).

The Danube River forms the southern boundary with Serbia and Bulgaria, and the river basin covers 97% of Romania, with 21.7 million Romanians residing within the pool (Gascoigne, 2009). Romania's water resources are generally limited, so they have taken great care to prepare for flood events both structurally and non-structurally with reservoir systems and reforestation programs as well as flood zone maps, education, and warning systems and public encouragement for flood insurance programs (ICPDR, 2006c).

The Danube River makes up the northern-most boundary between Serbia and Romania. Ten percent (10%) of the Danube River Basin is in Serbia and covers 92% of the country (Gascoigne, 2009). Serbia should have a lot of incentive to develop extensive water, and flood policies as 90% of its available water come from outside the country (ICPDR, 2006d). In northern Serbia, there are many levels, and in central Serbia, every major city lies in a flood plain. Serbia is prone to flash floods on smaller rivers and floods on significant rivers are common; yet, their flood protection policy is almost non-existent (ICPDR, 2006d).

Slovakia sits on the watershed divide between the Black Sea and the Baltic Sea and hosts parts of five different sub-basins of the Danube River (ICPDR, 2007c). Only 6% of the Danube River Basin is in Slovakia, but it covers 96% of the country and 5.2 million residents (Gascoigne, 2009). Slovakia experienced flooding often, but it is usually a result of snowmelt and occasionally summer precipitation. The cities are mostly already outfitted for flood protection along the major rivers (ICPDR, 2007c).

Figure 1. Map of Study Area Indicating Damage



1.3 Political Context

Germany is one of the most influential countries in all of Europe with the largest economy and largest population, besides Russia (CIA, 2017). Germany was one of the six original members of the EU and the Eurozone. Austria joined the EU in 1995 and has a fairly strong economy tied very closely to Germany. The Czech Republic, or Czechia, and Slovakia peacefully separated in 1993, and both joined the EU in 2004 (CIA, 2017). Bulgaria joined the EU in 2007, and as a former communist country still has one of the lowest per-capita incomes of EU members (CIA, 2017; World Bank, 2017). Romania was a communist nation until 1996 and also joined the EU in 2007 (CIA, 2017). Croatia joined the EU in 2013, and while it is the one of the wealthiest of the former Yugoslav Republics, for the countries affected by the 2013 flood, it is ranked 6th of 9, with a GDP higher only than Bulgaria, Romania, and Serbia (World Bank, 2017). Croatia was in an unusual situation during the flood as they were about to officially join the EU as of July 1, 2013, just after the flood. Therefore, they did not have any of the policy frameworks from the EU in place but were eligible to ask for EU aid after the flood. Serbia is the only country included in this study that is not a current member of the EU. With its turbulent past and ongoing negotiations about the independence of Kosovo, there is a goal for entry into the EU by 2025. Still, not much progress has been made since accession talks began in 2014 (CIA, 2017).

It is important to mention the government structures of each nation because the democratic nature and differences in form can influence whether the policy represents citizens' interests following the flooding event. The political structure of many of these countries is similar, most of which is a parliamentary republic with a civil law system in place. This goes for Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Serbia, and Slovakia (CIA, 2017). Romania is the only country in the study area with a slightly different government structure as a semi-presidential republic with a civil law system. In the Romanian executive branch of government, the President is directly elected by absolute majority, and a Prime Minister, appointed by the President with the consent of the Parliament. In Austria, Bulgaria, Croatia, Serbia, and Slovakia, the head of state is elected directly. In Germany and Hungary, the head of state is elected indirectly by the Federal Assembly by a simple majority and 2/3 majority respectively. The Czech Republic's head of state is now elected directly, but before the 2014 change in government, they were elected by the parliament.

The Czech Republic had a change of government in 2013-2014 and made it hard to look at small policy changes in the context of a huge structural shift. The new government of the Czech Republic that came into place in 2014 has been working on basic reforms to reduce corruption and maintain the economic strength of the country. Still, because of this turnover in the middle of the policy analysis time frame, there was a lack of data for any policy changes regarding disasters. It is unknown whether this is because of an actual lack of change or because action from the previous government was truncated.

The structure of the legislative branch is similar but varied in each of the countries involved. Each is either a bicameral or unicameral legislature with many different ways of electing their legislators. The legislative branch of Austria is a bicameral Federal Assembly consisting of the Bundesrat, appointed by each of the nine state parliaments, and Nationalrat, directly elected by proportional representation vote (CIA, 2017). The legislative branch has a unicameral Hrvatski Sabor with a variety of voting techniques, depending on the seat, from proportional representation to a simple majority by minority populations (CIA, 2017). The legislative branch of the Czech Republic has a bicameral Parliament with a Senate and Chamber of Deputies, or Poslanecka Snemovna, both directly elected for 6- and 4-year terms, respectively (CIA, 2017). The legislative branch is a bicameral Parliament consisting of the Federal Council or Bundesrat, appointed by state governments, and Bundestag, half elected by proportional representation and half elected by a simple majority (CIA, 2017). The legislative branch in Hungary is a unicameral National Assembly, about half directly elected by a simple majority and the other half elected by proportional representation along party lines (CIA, 2017). The Romanian legislative branch is a bicameral Parliament with a Sénat and Chamber of Deputies, both of which are elected by proportional representation via a party list (CIA, 2017). The Serbian legislative branch is a unicameral National Assembly with members serving in a single nationwide constituency and is elected by proportional representation by party affiliation (CIA, 2017). The Slovakian legislative branch is a unicameral National Council or Narodna Rada, elected for a nation-wide constituency by proportional representation (CIA, 2017). Bulgaria's legislative branch is a unicameral National Assembly, directly elected by proportional vote (CIA, 2017). This is represented in summary in Table 2.

There is an index of government corruption known as the Corruption Perception Index that measures "their perceived levels of public sector corruption" (CPI, 2017). In terms of reliability of representation, each country involved in the study ranks between 41-57 on the CPI, on a scale from 0-100 with 0 being highly corrupt. Germany and Austria are the only countries outside that range at 81 and 75, respectively (CPI, 2017). From this, we can gather that there is almost an equal comparison value between all the subjects, excluding Germany and Austria, which were already exceptional in their post-flood policy actions.

2. DATA AND METHODS

2.1 Life years

2.1.1 Life years Data

Evaluations of the 2013 flood came from several sources, each having varying numbers and no consensus on the actual results. Some sources even claimed different countries were impacted, also though they were not and vice versa. Data from multiple reports and databases were combined to get the most thorough picture of the flood impact. Switzerland, for example, was included in one flood report as being affected by the flood. Still, because there were no reports of damage or any details at all from that source or any other, Switzerland was not included in the analysis.

Noy's Life years measurement requires data for deaths, injuries, those made homeless, those affected, economic damage, recovery time, and per capita GDP (Noy, 2015; EM-DAT, 2017; Liska, 2014; ZIC, 2014; Monguzzi, 2013; World Bank, 2017; UN, 2015; UN, 2017; BLS, 2017; EUROPA, 2017; Pa, 2013). In the original model, precise data about each death and injury was used to determine exactly how many potential years were lost for each person killed (Noy, 2015). In this case, that level of specificity in data was not available, so an average age per country, based on the closest demographic information, was used instead (World Bank, 2017).

2.1.2 Life years Methodology

To determine Life years, a modified version of Noy's model was used to incorporate the function of a non-monetary measurement of disaster impact with only estimated and debated data available. The Life years formula is shown as Equations 1 through 6, incorporating the World Health Organization's disability-adjusted life year (DALY) and quality-adjusted life-year (QALY) as well as Noy's formulas. Noy's formula uses metrics for casualties (mortality), injured, affected, homelessness, and economic damage but the equation was made for the most detailed of disaster damage reports to which we did not have access in this case. An example of the calculations performed to obtain Life years is shown in Equation 7, for the case of Austria.

A compilation of the data used in this formula for each country is included in Table 1. There is no single damage report for this flood to give a number for each category in each country. Each source for damage and persons affected in the 2013 flood was slightly different depending on their measurement methods. Table 1 shows the averaged number for each country across the sources (BLS, 2017; EM-DAT, 2017; EUROPA, 2017; Fewtrell, 2013; Liska, 2014; Monguzzi, 2013; Pa, 2013; UN, 2015; UN, 2017; World Bank, 2017; ZIC, 2014).

Equation 1. Life years

$$\text{Lifeyears} = L(M, A^{death}, A^{exp}) + I(N) + F(N) + H(N) + DAM(Y, INC)$$

Equation 2. Mortality (L)

$$\text{Where } L(M, A^{death}, A^{exp}) = \sum_{m=1}^{M} (92 - A^{death})$$

M = number of deaths recorded

A^{exp}= 92, WHO measure of uniform life expectancy

A^{death}= age of death in each case, without that degree of detail we use the average age of citizens at the time of disaster

Equation 3. Injured (I)

$$\text{Where } I(N) = \alpha TN$$

α= for wounded and affected, 0.054, welfare reduction weight WHO DALY for "generic, uncomplicated disease; the anxiety of diagnosis."

T= time to return to normality for injured it is the length of injury which can be estimated by severity

N= number of wounded persons recorded

Equation 4. Affected (F)

$$\text{Where } F(N) = TN$$

T= time to return to normality

for affected, it is the length of time it took the country to recover (usually

in years)

N= number of affected persons recorded

Equation 5. Homelessness (H)

$$\text{Where } H(N) = \beta N$$

β= for homeless, 0.117, WHO QALY

N= number of homeless persons recorded

Equation 6. Economic Damages (DAM)

$$\text{Where } DAM(Y, INC) = \frac{(1 - c)Y}{INC}$$

c= 0.75, acknowledging that we spend most of our time on non-work activities

Y= damage estimates

INC=per capita income at the time of disaster

Equation 7. Example Life years Calculation of 2013 Flood in Austria

$$\text{Lifeyears} = \sum_{m=1}^{4.75} (92 - 41.42) + (0.054 * 0) + (0.5 * 200) + (0.117 * 500) + \frac{(1 - 0.75)616298774.33}{53965.43}$$

Table 1. Flood Impact Data Averaged Across Sources

Country	Death	Injury	Homeless	Affected	Damage	Recovery Time	Average Age	Per Capita GDP	Lifeyears
					USD (2018)	Fraction of a Year		USD (2018)	
Austria	4.75	-	500.00	200.00	616,298,774.33	0.50	41.42	53,965.43	3,253.81
Bulgaria	-	-	-	248.40	1,839,661.58	0.33	41.87	8,166.05	139.12
Croatia	-	-	-	-	141,512.43	0.33	41.66	14,443.52	2.45
Czech Republic	11.00	-	12,666.67	882,266.67	566,644,314.46	0.50	42.17	21,190.64	449,848.54
Germany	4.00	-	7,350.00	29,425.00	5,401,713,901.63	2.00	47.46	49,508.89	87,164.59
Hungary	-	-	-	48,565.00	82,077,209.01	0.25	42.02	14,542.44	13,552.24
Romania	4.00	-	-	1,468.80	65,237,229.92	0.42	42.16	10,198.72	2,410.51
Serbia	-	-	-	-	396,234.80	0.08	36.82	6,760.47	14.65
Slovakia	0.50	1.00	245.00	892.00	17,173,948.42	0.33	37.31	19,355.88	575.18

2.2 Policy Change Analysis

2.2.1 Policy Change Data

Policies were obtained from each country's government websites, records, and various reports on the subject. Because of limitations in English content, only systems on the national level are included on a more broad scale, and local flood policies are mentioned anecdotally. Information about government structure and transparency came from country profile reports and international public databases (CIA, 2017; CPI, 2017). Most of the policy information was derived from public records from the civil law systems, from UN reports of disaster risk program progress, or requests for aid, where the countries themselves are self-reporting their policies and policy goals as well as the circumstances around them. While these reports could be considered biased because they are self-reported, for our purposes, they were deemed reliable. It is in each country's best interest to be the most thorough as far as current policy but to also not exaggerate as the UN could quickly check on any reported claims.

2.2.2 Policy Change Methodology

Disaster policy changes were difficult to identify in some cases and therefore, were only compared for countries with policy information available to the public. Each country's policy changes were considered in context with previous policies that were already in place. As well as their government structure and general relationships with their citizens, i.e. are they known to be more representative of public concerns or more separated by corruption or dictatorship. These policy changes are described qualitatively in terms of the content of the change because they are specific to disaster policy and account for adjustments and expansions of very specific policies.

3. RESULTS

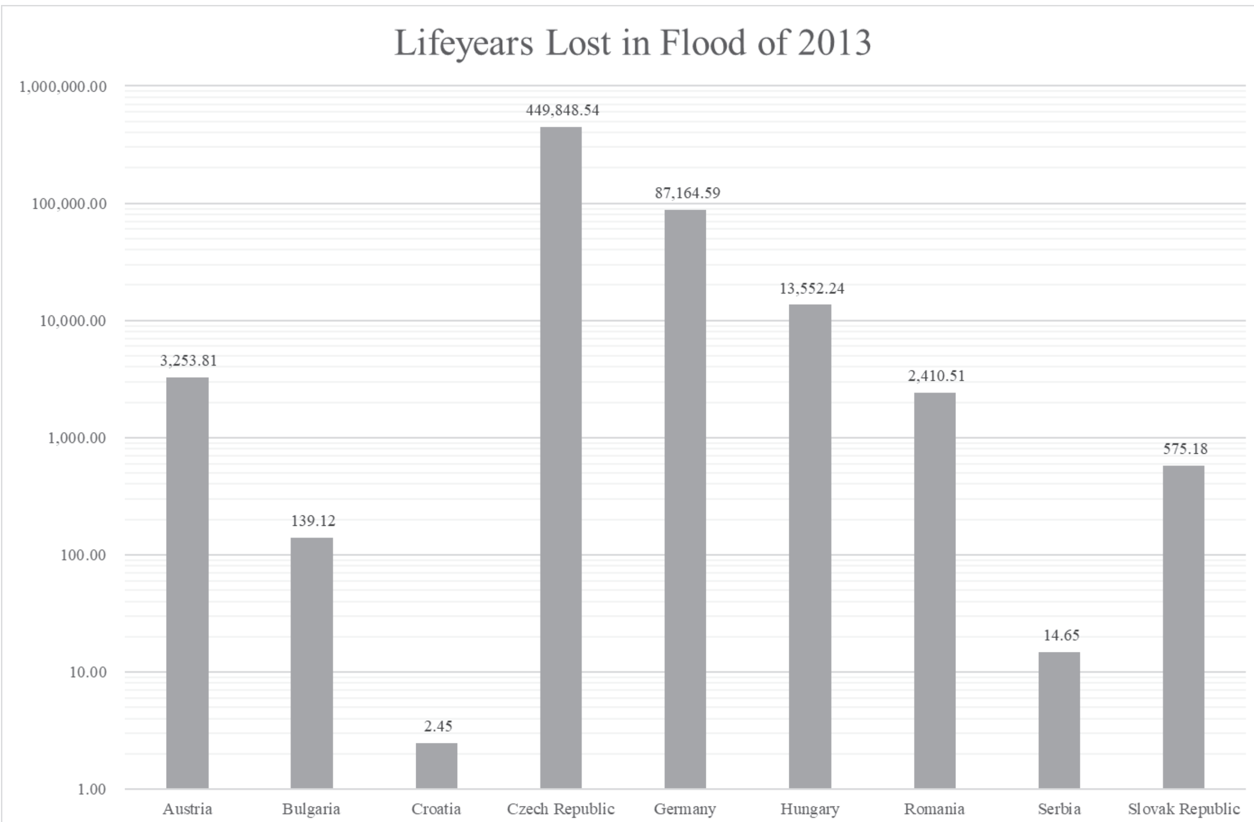
Table 2. Life years and Policy Change Results with Brief Country Profile Ordered By Damage

Country	Population (2013)	EU	Government Type	Flood Damage (Life years)	Policy Change
Czech Republic	10,514,272	Since 2004	parliamentary republic with a civil law system (enacted in 2014) – bicameral legislature Senate and Chamber of Deputies, or Poslanecka Snemovna (elected by party-list proportional representation)	449,849	**Change in government mid-study period
Germany	80,645,605	Original Member	parliamentary republic with a civil law system – bicameral legislature Bundesrat (appointed by state governments) and Bundestag, (half elected by proportional representation and half elected by simple majority)	87,165	A national and international agreement with Austria
Hungary	9,893,082	Since 2004	parliamentary republic with a civil legal system - unicameral National Assembly (half directly elected by a simple majority and the other half elected by party-list proportional representation)	13,552	National policy change
Austria	8,479,823	Since 1995	parliamentary republic with a civil law system – bicameral legislature Bundesrat (appointed by nine state parliaments) and Nationalrat (directly elected by proportional representation vote)	3,254	National (procedural) and International agreement with Germany
Romania	19,983,693	Since 2007	a semi-presidential republic with a civil law system – bicameral Parliament with a Senat and Chamber of Deputies (elected by party-list proportional representation)	2,411	**Not enough public policy information to make conclusions
Slovakia	5,413,393	Since 2004	parliamentary republic with a civil law system – unicameral National Council Narodna Rada (elected for a nation-wide constituency by proportional representation)	575	A national and international agreement with Ukraine
Bulgaria	7,265,115	Since 2007	parliamentary republic and a civil law system – unicameral legislature (directly elected by proportional vote)	139	No

Serbia	7,186,862	NO	parliamentary republic with a civil law system – unicameral National Assembly (elected by party-list proportional representation)	15	No (National policy change after 2014 flood with much larger impact)
Croatia	4,255,689	Since July 2013 (1-month post-flood)	parliamentary republic with a civil law system – unicameral legislature Hrvatski Sabor (elected by a variety of voting methods depending on the seat)	2	No (National policy change after 2014 flood with much larger impact)

Figure 2. Total Lifeyears Lost

Graphical representation of Table 2 on a logarithmic scale.



Life years measurements, shown in Table 2 and graphically in Figures 1 and 2, indicate the most affected country was the Czech Republic by a large margin. Next was Germany, followed by Hungary, Austria, Romania, Slovakia, Bulgaria, Serbia, and last Croatia.

The Czech Republic, which was the most impacted, did not have much information available regarding any disaster policy, so no conclusions were able to be made about an evaluation of policy changes. A few actions were mentioned in press conferences from the new Czechia government, but none of the statements related to these policies mentioned the 2013 floods specifically. The Czechia government did say the 2002 wave in one instance (Brabec, 2015; Sequensová, 2014).

Germany experienced the major flood of the Elbe River in 2002 and made changes that were adopted in 2005 to improve flood control and define 100-year flood plains (Mrzyglocki, 2015). The full implementation of 100-year flood plain maps was to be done by 2012 and have flood risk management plans done by 2015. The policy also established legal responsibilities for each level of government in flood prevention, warning, and recovery, and funding for research was planned to develop a common strategy for adaptation to climate change. Even with the previous policy changes from floods in the past, Germany did have an acknowledgement of lessons learned from the 2013 flood in their national plan in 2015 when they observed that social media played a role in informing those affected and allowing more efficient distribution of volunteers and first responders (Mrzyglocki, 2015). The goal of the plan was to use this observation to ensure the communication is accurate and efficiently managed.

Hungary faced immense damage across the country from the flood. They publically acknowledge that despite the high economic loss and many people affected, there were no casualties in Hungary. They attributed this to its "prevention and resilience measures" (Bakondi, 2015). To deal with the high number of people affected by damages, the government instituted a new way to compensate for disaster damages following the flood (Bakondi, 2015).

Austria's reaction post-flood in terms of disaster policy was to alter its budget to speed previously docketed flood protection plans. While this is a reaction and is a policy change, it is not a change to include new content (Pichler, 2016). Romania lacked in public information at all and no conclusion was made as to their policy response post-flood.

Slovakia already had some flood protection policies in place before the flood, namely a partnership with Ukraine for an early warning system across both of their at-risk populations (Burian, 2015). Post-flood Slovakia has moved to create more mitigation and protection plans instead of just warnings (Burian, 2015). Bulgaria had virtually no policy change shown. Even in public statements on risk reduction, they made no mention of past disasters or any reason to make disaster policy changes in the future. Serbia and Croatia didn't have any attributable policy change either but did in later flood events as will be discussed later.

Observations of regional and international cooperation were also found following the floods. In 2014, the state of Bavaria in Germany and the state of Upper Austria in Austria signed agreements on joint flood research and cross-border flood protection measures. They stated the motivation being the effects of the floods of the Oder river in 1990 and the Elbe river in 2002 and 2013 (Mrzyglocki, 2015).

4. DISCUSSION/CONCLUSION

The results show, as far as the available data, that the countries with the most progress in policy following the 2013 floods were Germany and Hungary. Also, supporting the hypothesis, Austria and Slovakia lost more Life years concerning some of their flood-affected neighbours, and in turn, had changed to their disaster policy following the flood. This supports the hypothesis that countries respond to non-monetary damages with policy change.

For each country, there is a very different background of policy pre-2013, many have been influenced by previous floods, but not always in the same ways or to the same degree. There was a major flood of the Elbe River in 2002 and another flood of Danube in 2005. Climatologically, floods have been increasing over time with three new records set since 2002 (Gascoigne, 2009).

The least impacted countries: Bulgaria, Croatia, and Serbia, had virtually no policy change in response to the flood. For Bulgaria, the Bulgarian corruption perception score is 43, the second-lowest in the study region (CPI, 2017). This indicates that the government is not known to be connected with the citizens' interests, so policies may not be expected to follow logically after a disaster as those with less corruption would. In the case of Serbia and Croatia, especially, this was not just a function of an unconnected government because both had a legitimate response to a larger flood the year after (EM-DAT, 2017; Holcinger, 2015; Blagojevic, 2017). In Croatia, they had a devastating flood in 2014 that is mentioned in subsequent policy numerous times while the 2013 flood was not mentioned. Even in the 2014 flood, the statements made in government reports offer only vague objectives, for example, *"Recent events in Croatia (2014 floods in Slavonia) will result in many lessons learnt that should be supplemented by lessons learned from future cooperation and exercises and implemented into legislation and practice to economize resources and avoid duplications and lack of coordination of activities in all phases of disaster management."* (Holcinger, 2015:44)

The Croatian flood of 2014 in Slavonia, based on a non-exhaustive search for damage statistics, would be estimated at 151,906.02 Life years lost, which would put that flood at about the same level as the magnitude Hungary experienced in the 2013 flood (EM-DAT, 2017). It makes more sense in that context why the government would be much more inclined to make policy changes as a result of that flood rather than the one in this natural experiment. Serbia was much the same case; they were severely affected by the same May 2014 flood that Croatia experienced, and they made substantial changes to flood policy following that flood rather than the locally less intense flood of 2013. Following the 2014 flood, Serbia requested aid from the European Union, World Bank, and the United Nations to establish flood protection. A disaster risk reduction program, a post-disaster reconstruction law, and, after recovering, even became a donor to the Global Facility for Disaster Reduction and Recovery to help pay it forward for the aid they received (Blagojevic, 2017).

No conclusions were made about Romania or the Czech Republic because of a lack of information. While the Czech Republic did not seem to have any policy changes concerning the flood, it is still unknown if this is because there was no reaction or if it was a function of their government structure change in 2014 and lack of public record.

A specific threshold for policy change could not be distinguished without more comprehensive data. This analysis opens many new avenues into efficiency evaluations of post-flood policies and the evolution of national disaster risk reduction plans. Toward this goal, though, the Croatian and Serbian response to this flood in comparison to their more intense flood the next year shows the relationship between disaster magnitude and policy change does exist in at least one case (Holcinger, 2015; Blagojevic, 2017).

5.0 REFERENCES

1. Bakondi, G. (2015). 'Hungary: Statement made at the Third UN World Conference on Disaster Risk Reduction (WCDRR),' Third UN WCDRR in Sendai, Japan, March 2015. Accessible at http://webtv.un.org/meetings-events/conferencessummits/3rd-un-world-conference-on-disaster-risk-reduction-14-18-march-2015-sendai-japan/watch/representative-from-hungary-5th-plenary-meeting/4113612423001

2. Birkland, T. (2004) 'Risk, Disaster, and Policy in the 21st Century,' The American Behavioral Scientist 48(3):275-280.

3. Birkland, T. (2006). Lessons of Disaster: Policy Change After Catastrophic Events. Washington D.C., Georgetown University Press.

4. Blagojevic, M. (2017). 'Serbia: Statement made at the Global Platform for Disaster Risk Reduction (2017)' Global Platform for Disaster Risk Reduction in Cancun, Mexico, May 2017. Accessible at https://www.unisdr.org/conferences/2017/ globalplatform/en/programme/statements

5. Bloschl, G., T. Nester, J. Komma, J. Parajka, and R.A.P. Perdigao (2013). 'The June 2013 flood in the Upper Danube Basin, and comparisons with 2002, 1954, and 1899 floods,' Hydrology and Earth System Sciences 17:5197-5212.

6. Brabec, R. (2015). 'Czech Republic: Statement made at the Third UN World Conference on Disaster Risk Reduction (WCDRR),' Third UN WCDRR in Sendai, Japan, March 2015. Accessible at http://webtv.un.org/meetings-events/conferencessummits/3rd-un-world-conference-on-disaster-risk-reduction-14-18-march-2015-sendai-japan/watch/richard-brabec-czech-republic-3rd-plenary-meeting/4111990609001

7. Breinl, K. (2015). 'After the Deluge: Revisiting the Central Europe Floods of

2005,' AIRCurrents. Accessible at http://www.air-worldwide.com/Publications/AIR-Currents/2015/Ten-Years-After-the-Deluge--Revisiting-the-Central-Europe-Floods-of-2005/

8. Burian, P. (2015) 'Slovakia: Statement made at the Third UN World Conference on Disaster Risk Reduction (WCDRR),' Third UN WCDRR in Sendai, Japan, March 2015. Accessible at http://webtv.un.org/meetings-events/conferencessummits/3rd-un-world-conference-on-disaster-risk-reduction-14-18-march-2015-sendai-japan/watch/peter-burian-slovakia-2nd-plenary-meeting/4110958028001

9. Bureau of Labor Statistics (BLS) (2017). 'Consumer Price Index Data from 1913 to 2017,' U.S. Department of Labor, U.S. Inflation Calculator. Accessed 18 December 2017. Accessible at http://www.usinflationcalculator.com/ inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/

10. CIA World Factbook (2017). Washington, DC: Central Intelligence Agency, 2017. Accessible at https://www.cia.gov/library/publications/the-world-factbook/index.html

11. Corruption Perceptions Index (CPI) (2017). Transparency International. Accessible at https://www.transparency.org/news/feature/corruption_perceptions_index_2017#table

12. EM-DAT: The Emergency Events Database - Université Catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium. Accessed 7 Sept 2017.

13. EUROPA (2017) '8.2 Bilateral exchange rates' Statistics Bulletin. Accessed 12 December 2017. Accessible at http://sdw.ecb.europa.eu/servlet/desis?node= 10000071

14. Fewtrell, T., G. Hadzilacos, A. Werner, and T. Kiessling (2013). '2013 Elbe and Danube Floods in Germany, Austria, and Central and Eastern Europe,' Flood Damage Survey Report eVENT.

15. Gascoigne, O. (2009). 'The Danube River Basin: Facts and Figures,' International Commission for the Protection of the Danube River (ICPDR).

16. Grams, C.M., H. Binder, S. Pfahl, N. Piaget, and H. Wernli (2014). 'Atmospheric processes triggering the central European floods in June 2013,' Natural Hazards and Earth System Sciences 14:1691-1702.

17. Holcinger, N. (2015). 'National Progress Report on the Implementation of the Hyogo Framework for Action (2013-2015),' National Protection and Rescue Directorate. Accessible athttps://www.preventionweb.net/files/40137_HRV_ NationalHFAprogress_2013-15.pdf

18. ICPDR (2006a). 'Danube Facts and Figures: Austria,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/AT%20Facts%20Figures.pdf

19. ICPDR (2006b). 'Danube Facts and Figures: Hungary,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/HU%20Facts%20Figures.pdf

20. ICPDR (2006c). 'Danube Facts and Figures: Romania,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/RO%20Facts%20Figures.pdf

21. ICPDR (2006d). 'Danube Facts and Figures: Serbia,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/CS%20Facts%20Figures.pdf

22. ICPDR (2007a). 'Danube Facts and Figures: the Czech Republic,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/CZ_Fact_Figures.pdf

23. ICPDR (2007b). 'Danube Facts and Figures: Germany,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/DE_Facts_%20Figures.pdf

24. ICPDR (2007c). 'Danube Facts and Figures: Slovakia,' ICPDR. Accessible at https://www.

icpdr.org/flowpaper/viewer/default/files/SK%20Facts%20Figures.pdf

25. ICPDR (2010). 'Danube Facts and Figures: Croatia,' ICPDR. Accessible at https://www.icpdr.org/flowpaper/viewer/default/files/Croatia%20Facts%20Figures.pdf

26. ICPDR (2017). 'Danube Facts and Figures: Bulgaria,' ICPDR. Accessible at https://www.icpdr.org/main/danube-basin/bulgaria

27. JBA Risk Management (2014). 'JBA and MET Office: Central European Floods June 2013 (As of 11 June)'. Accessible at http://www.jbarisk.com/jba-and-met-office-central-european-floods-june-2013-11-june

28. Liska, I. (2014). 'Floods in June 2013 in the Danube River Basin: Brief overview of key events and lessons learned,' ICPDR.

29. Monguzzi, A. and L. Norgaard (2013). 'Information Bulletin: Central Europe Floods' International Federation of Red Cross and Red Crescent Societies (IFRC), 5 June 2013. Accessible at https://reliefweb.int/sites/reliefweb.int/files/resources/ IB%20FL-2013-000068-CZEDEUCHEAUT.pdf

30. Mrzyglocki, R. (2015). 'National Progress Report on the Implementation of the Hyogo Framework for Action (2013-2015),' German Committee for Disaster Reduction. Accessible athttps://www.preventionweb.net/files/41488_DEU_ NationalHFAprogress_2013-15.pdf

31. Noy, I. (2015). 'A Global Comprehensive Measure of the Impact of Natural Hazards and Disasters' Global Policy 7(1):56-65.

32. Pa, D. (2013). 'A Total of 8 Dead in Flood – The Risk of Dike Breaches,' Badische Zeitung 12 June 2013. Accessible at http://www.badische-zeitung.de/nachrichten/panorama/insgesamt-8-tote-bei-hochwasser-weiter-gefahr-von-deichbruechen--72691971.html

33. Pichler, D. (2016). 'Flood Protection for the Danube in Lower Austria,' Congress Office Interpraevant 2016. Accessible at http://www.interpraevent.at/palm-cms/upload_files/Publikationen/Tagungsbeitraege/2016_EA_42.pdf

34. Scolobig, A., J. Linnerooth-Bayer, M. Pelling (2014). "Drivers of Transformative Change in the Italian Landslide Risk Policy." International Journal of Disaster Risk Reduction 9: 124-136.

35. Sequensová, K. (2014). 'Czech Republic: Statement made at the Preparatory Committee (PrepCom 1) of the Third UN World Conference on Disaster Risk Reduction (2014),' Third UN World Conference on Disaster Risk Reduction, July 2014. Accessible at https://www.preventionweb.net/files/globalplatform/statementczechrepublic.pdf

36. Serra-Llobet, A., J.D. Tabara, D. Sauri (2013). "The Tous Dam Disaster of 1982 and the Origins of Integrated Flood Risk Management in Spain." Natural Hazards 65: 1981-1998.

37. United Nations (UN) (2015) 'World Population Prospects: The 2015 Revision,' UN Department of Economic and Social Affairs, Population Division.

38. UN (2017) 'Household Size and Composition Around the World,' Accessible at http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf

39. World Bank (2017). World Development Indicators, Accessed 12 December 2017. Accessible at https://data.worldbank.org/products/wdi

40. ZIC Insurance Company Ltd. (2014). 'Risk Nexus | Central European floods 2013: a retrospective,' Zurich Insurance Company Ltd.