

# NON-STRUCTURAL FLOOD HAZARD ALLEVIATION IN LA CROSSE, WISCONSIN, USA

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## Abstract

Based on a pilot survey among the residents of the 100-year flood zone (N = 90), this study assesses urban floodplain residents' preferences for structural vs. non-structural flood hazard alleviation in La Crosse, Wisconsin. The study found that the respondents' preference for structural measures, such as upgrading flood control levees (mean Likert scale score: 4.06), outweighed that for such semi-structural and non-structural measures as flood-proofing personal property (mean scores: 1.94—2.15) and relocation (2.26). Among non-structural measures, the respondents disapproved several provisions of the National Flood Insurance Program (NFIP): nearly two-thirds stated that they had to purchase flood insurance as a mortgage requirement, another one-half contended that the premium was too high, only one-third had purchased flood insurance voluntarily, and 12% asserted that flood insurance was unnecessary for their property because it had never flooded before. In contrast to the survey respondents' preferences, the content analysis of *The La Crosse Tribune* discourse on flood problems, published between 1931 and 2005, indicated that although three-quarters of its flood reports were on routine events, nearly one-half of the *Tribune* column space for floods was on flood alleviation, emphasizing significantly more on non-structural than on structural measures. The study recommends follow-up research to explore the underlying causes of such disapproval of the NFIP by floodplain residents, especially in the contexts of their understanding of the principles of flood risk mapping for flood insurance and the role of the *La Crosse Tribune* articles in improving their understanding of these issues.

**Key words:** Mississippi floods, Flood alleviation measures, Flood insurance, Newspaper Discourse

## 1. Introduction

The term urban floodplain refers to the generally low-lying and flat land along an urban river which is inundated during periods of high water (Rasid 1988). The potential for flood damage is particularly high in urban floodplains because of high economic values of their extensive urban-industrial infrastructures and real-estate properties. For example, during the 1993 Great Midwestern flood in the Mississippi—Missouri Basin major flood losses were experienced by numerous urban settlements along the Mississippi (Bhowmik 1994; Chagnon 1996). To minimize flood losses, most of the urban floodplain management authorities in the United States have developed a mix of complementary policies of protecting existing properties by structural and semi-structural measures and preventing further encroachment of flood-labile lands using a number of non-structural measures. Structural measures are major engineering interventions designed for flood abatement, such as flood control levees for preventing over-bank inundation, dams and reservoirs for storing floodwaters, and channelization projects for improving flow conveyance (Rasid 1987; Alexander 1993). Non-structural approaches, on the other hand,

involve measures to prevent and minimize flood damage, such as land use regulations for preventing floodplain occupancy and economic measures (e.g., flood insurance) for redistributing flood compensation among the floodplain residents (James 1975; Arnell 2000).

One of the major challenges faced by urban floodplain management authorities in the United States is the public attitude towards structural vs. non-structural flood alleviation measures. For more than a century they have been accustomed to the concept of flood control through dams and levees, which has been the outcome of a gradual evolution of policies from initially 'levees only' in the Mississippi Basin to a combination of levees and other supplemental structural measures, such as reservoirs, fuse-plug levees, floodways, and channel improvement projects (Wilkins 1996). Floodplain residents' reliance on structural flood alleviation is, thus, consistent with the goal of a society accustomed to mastery of its environment through technology (Smith 1992). Another hypothesis related to avoiding personal responsibility for floodplain occupancy is that most of the floodplain residents in USA have developed an attitude of relying on federal disaster assistance for recovering their personal flood losses (Kunreuther and White 1994). The news media discourse plays an important role in shaping public attitudes towards natural hazards and disasters. Although most of the media discourse tends to focus on major engineering interventions as the solutions of local flood problems, mass communication specialists suggest that the news media can play a symbolic role in hazard mitigation through critical discourse on alternative hazard alleviation measures (Wilkins 2000, Walters *et al.* 1989). The present study is a preliminary investigation designed to test this hypothesis. Based on a pilot survey among the residents of the 100-year flood zone in La Crosse, Wisconsin and content analysis of *The La Crosse Tribune* flood archives, the specific objective of this article is to assess if floodplain residents' preferences for flood alleviation measures in La Crosse were consistent with the *Tribune* discourse on these measures.

## 2. Flood problems in La Crosse

La Crosse, a Wisconsin city of 51,000 with a metropolitan and county population of about 107,000 (US Department of Commerce 2000), is situated on the left bank of the Mississippi River across from the Minnesota—Wisconsin border (at the intersection of Longitude 91°12' W and Latitude 43°50' N). In the vicinity of La Crosse the Mississippi River is a part of the Upper Mississippi Basin and is bordered by discontinuous and relatively narrow floodplains (2 to 5 km wide), which are confined on both sides by a series of steep-sided Cambrian Lower Magnesian dolomite bluffs, 70—200 m high (Martin 1965). Most of the urban development in the La Crosse area has been confined between the bluffs and the left bank of the Mississippi—a distance of 2 to 4 km with an average slope of about 2—3 m/km. Most of the residential districts in the city have been built in flood-free areas on higher grounds closer to the bluffs. Yet, there are several flood areas in La Crosse, which experience occasional flooding from the Mississippi. First, in the northern section of the city there are major flood-labile areas in French Island (a channel bar of the Mississippi) and the adjacent township of Campbell. Second, the most extensive flood-prone areas are located in the La Crosse River Marsh area, situated in the middle section of the city between the Black River (in the north) and the La Crosse River (in the south), the two most important tributaries of the Mississippi. During high-magnitude floods the marsh acts as a flood detention basin but several low-lying areas adjacent to the marsh experience flooding. Third, additional flood-prone areas are located in the southern section of the city in a narrow strip of land along the river bank.

The City of La Crosse experienced the Mississippi floods approximately nineteen times out of 68 years of continuous stream flow record (1938—2005). The spring flood of 1965 had the highest

magnitude with a record level of 196.28 m (644 ft) above sea level, i.e. 5.4 m (17.74 ft) above the datum and 1.74 m (5.74 ft) above the bankful stage. This historic flood had a record discharge of 7530 m<sup>3</sup>/s (265,900 cfs). The second highest flood occurred in the spring of 2001 with a flood level of 195.69 m (642.08 ft) or 1.16 m (3.83 ft) above the bankful stage. The Great Midwest flood of 1993, which was the most catastrophic flood of the lower Mississippi in the 20<sup>th</sup> century (Tobin and Montz 1994), was much less significant at La Crosse ranking only fifth in magnitude behind the floods of 1997 (third) and 1969 (fourth).

### 3. Survey of floodplain residents

Using the standard floodplain mapping tools, such as hydraulic models and digitized computer maps, the Federal Emergency Management Agency (FEMA) has delineated boundaries of several flood zones in La Crosse for the purpose of preparing Flood Insurance Rate Maps (FIRMs). Among them the following three zones are relevant for the purpose of this study: (a) a floodway in which no construction is allowed, (b) a 100-year flood zone (the main flood zone), i.e. parcels of lands with 1% annual chance of flooding, and (c) a 500-year flood zone with 0.2% annual chance of flooding. Since the probability of a 500-year flood in a given year is extremely low (0.2%), the main interest of the survey was the 100-year flood zone, which is the national standard for the base flood for all FIRMs (FEMA 2002). There are about 350 residential properties in La Crosse within the 100-year flood zone. A sample of 90 respondents was drawn by a combination of random sampling of streets (using computer-generated random numbers for the streets with the flood zone) and systematic sampling of respondents (i.e. selecting every few houses proportionate to the numbers of houses on a given street). A door-to-door interview was conducted for completing the surveys. There were some replacement samples when the selected household residents were absent or refused to have an interview.

The survey results indicated that very few respondents had experienced the flood problems directly in their property (N = 21—23). The most common type of flood damage reported was flooding in the basement but this was in the form of minor seepage of water in the basement floor and along the basement walls. Flooding of the yard was reported by even fewer respondents: 13 in 1965 and other years and 4 in 2001.

Most of the flood-labile homes were constructed prior to the enactment of the National Flood Insurance Program (NFIP) and did not require flood-proofing for mortgage loan. Post-NFIP flood-proofing measures consisted largely of raising the foundations of homes above the 100-year flood level. One of the objectives of this study was to investigate how such flood-proofing measures compared with other structural and non-structural flood alleviation measures as floodplain residents' preferences. The respondents were asked to use a 5-point Likert scale indicating their preferences from a mix of such measures. The aggregate scores of the Likert scale, reported in Table 1, confirmed the central assumption of floodplain residents' continued reliance on structural flood alleviation measures, as the survey respondents indicated the highest preference for a classic engineering intervention, i.e. upgrading levees (mean Likert scale score: 4.06). In contrast, flood-proofing the entire property was rated by the respondents well below 3, the neutral point of the scale (with an aggregate of 1.94). Relocation to flood-free lands, which is considered as a non-structural measure, despite the physical relocation of the structure or a physical move by a resident, was not also rated favorably (2.26), although it was widely implemented elsewhere in the Mississippi floodplain following the 1993 flood (Tobin and Montz 1997).

**Table 1** Respondents' preferences for flood alleviation measures ( $N = 90$ )

<i>Flood alleviation measures</i>	<i>Mean Likert score*</i>
Upgrade levees	4.06
Flood-proof electric outlets	2.85
Relocate	2.26
Flood-proof garage	2.15
Flood-proof entire property	1.94

Source: Authors' 2006 survey

\*Likert scale used in the survey: 1 = Not at all preferred, 2 = Not preferred, 3 = No opinion on preference, 4 = Preferred, 5 = Highly preferred

The main problem with the respondents' preference for upgrading levees is that in the past such measures had failed during high magnitude floods. Extensive levee breaches during the Great Midwestern flood of 1993 are, perhaps, the most recent reminder of failure of levees to provide complete flood protection (Myers and White 1994; Tobin and Montz 1994). The results of the present study indicate that, notwithstanding such recent examples of levee failure in the Mississippi Basin, the floodplain residents of La Crosse continue to prefer flood-control levees as their solutions for personal flood problems.

**Table 2** Lack of support for flood insurance ( $N = 90$ )

<i>Flood insurance issues</i>	<i>N</i>	<i>Percent of respondents</i>
Purchased flood insurance as a mortgage requirement	57	63
Purchased flood insurance involuntarily	55	61
Premium was too high	45	50
Purchased flood insurance voluntarily	30	33
Thought property would never flood	11	12
Would purchase flood insurance at discount rates	8	9

Source: Authors' 2006 survey

The lack of support for non-structural measures was further evident from respondents' disapproval of several provisions of the National Flood Insurance Program (NFIP), although the latter was designed by the US Congress in 1968 so that the floodplain residents could "live with the flood" using proceeds from the general flood insurance premium fund and redistributing it among fewer flood victims (Arnell 2000). Contrary to the expectation of large-scale adoption of this program among nearly 350 residential properties within the 100-year flood zone, the survey data indicated minimum participation in the NFIP and widespread negative attitudes towards the program (Table 2). Thus, only about one-third of the respondents purchased flood insurance voluntarily and the remaining two-thirds had subscribed to the program involuntarily, mainly as a mortgage requirement. A small minority ( $N = 9$  or 12%) asserted that flood insurance was

unnecessary for their property because it had never flooded before. A familiar complaint was that the premium was too high (N = 45 or 50% of the respondents), whereas a limited few (N = 8) would have purchased flood insurance at discounted rates.

#### 4. Newspaper discourse on flood alleviation measures

News media discourse on natural disasters tends to decontextualize catastrophic events by framing them as discrete news items (Wilkins 1996 and 2000). This allows journalists to “routinize the unexpected” (Tuchman 1973), that is, to transform a disaster into a manageable problem by focusing on the event rather than on underlying causes and mitigation strategies (Wilkins 1996). A significant outcome of this approach is that most of the news media coverage of natural disasters tends to follow Anthony Downs’ (1972) “issue-attention cycle”, by clustering news accounts during the immediate impact stage and at the early post-recovery period. With the passage of time, interests in reporting on the topic would wane. The news media coverage of a catastrophic flood event provides a classic example of this issue-attention cycle in reporting. Most of the national news media would cover such a catastrophic flood during high water levels and would end their coverage when the water recedes. In the process, some of the most significant post-disaster national debates on flood mitigation strategies may be omitted from the media discourse. The regional newspapers, such as *The La Crosse Tribune*, in contrast, seem to have more extensive coverage of local disaster news linking them to broader national disaster management policies. Using the content analysis data from *The La Crosse Tribune* reports on the Mississippi floods, published between 1931 and 2005, one of the objectives of this study was to assess the nature of flood news published in this regional newspaper, especially focusing on its balance between routine flood news and contextual articles on structural vs. non-structural floodplain management.

The main data source for *The La Crosse Tribune* content analysis consisted of a set of archived items by the La Crosse Public Library. This consisted of a collection of clips and photocopies of *The La Crosse Tribune* reports, editorials and contextual articles on floods in the La Crosse area. In all, 1056 items published between 1931 and 2005 were analyzed. The content analysis was conducted manually, i.e. without any software, and consisted mainly of frequency counts of reports in which a selected number of pre-determined key words appeared, namely routine flood events, flood damage, and flood alleviation measures. The latter included structural measures and non-structural measures, such as floodplain mapping and zoning, flood-proofing, and flood insurance (Table 3). In addition to the frequency counts of reports by key words, the column space of an article was estimated by multiplying the total column length of each article with the average numbers of lines in a full column.

The frequency counts indicated that approximately three-quarters of all flood reports published in the *Tribune* were on routine flood events, such as the progression of water levels, causes of high water levels, and flood damage. The seriousness of flood problems in the City of La Crosse is reflected in the fact that the *Tribune* published at least 417 reports with references to various types of flood damage. Among them the largest numbers of reports dealt with damage to public infrastructures, such as dike failure, levee breaches, seepage under levees, submergence of roads and railroads, and closure of roads (N = 205). Unlike most of the national news media which tend to cover flood news only during high magnitude events (Wilkins 1996), *The La Crosse Tribune* published numerous contextual articles dealing with both structural and non-structural flood mitigation strategies, many of which were published well beyond the flood stage in the Mississippi (Table 3). Among structural measures the largest numbers of references were on flood control levees (N = 45) and temporary dikes and sandbagging (N = 31). While levees are

the most significant flood control structures of the lower Mississippi, they are less prominent in the La Crosse area (Upper Mississippi Valley) which is dominated by the locks and dams systems. Among non-structural measures, floodplain mapping and zoning commanded the largest amount of coverage (82 articles). This was followed by 28 articles on flood insurance and 25 articles on flood-proofing. More importantly, the *Tribune* devoted proportionately greater amount of column space for non-structural flood alleviation measures (59% of total flood alleviation measures), compared to structural measures (41%). Not only the non-structural measures accounted for a significantly larger proportion of column space for flood alleviation measures, these represented nearly one-half (47%) of the total column space for flood news published in the *La Crosse Tribune* (Table 3).

Table 3 Number of The La Crosse Tribune reports and column space for flood alleviation measures, 1931–2005

<i>Concepts reported*</i>	<i>Number of reports</i>	<i>Column space (number of lines)</i>
<i>Structural measures:</i>		
Secondary infrastructures**	73	
Permanent flood control levees	45	
Temporary dikes, sandbagging	31	
Flood retention ponds	14	
Flood storage dams and reservoirs	12	
<i>Total structural measures</i>		7,828
<i>Percent of structural and non-structural measures</i>		41
<i>Non-structural measures:</i>		
Flood studies	136	
Floodplain mapping and zoning	82	
Flood insurance	28	
Flood-proofing	25	
Annexation/ acquisition/buyout	21	
Flood emergency measures	18	
Flood preparations	11	
<i>Total non-structural measures</i>		11,145
<i>Percent of structural and non-structural measures</i>		59
<i>Non-structural measures as percent of total flood news</i>		47

\* Concepts may overlap among several reports

\*\*Sewers, culverts, pumping stations, etc

Source: Authors' content analysis

## 5. Conclusion

Clearly the *La Crosse Tribune* had a major emphasis on non-structural flood alleviation measures. Contrary to the initial assumption that news media can play a symbolic role in hazard mitigation through critical discourse on alternative hazard alleviation measures, the *Tribune* discourse on

non-structural flood alleviation measures seemed to have very little influence on the La Crosse floodplain residents' attitudes towards these measures. This raises two inter-related questions dealing with the readership of the *La Crosse Tribune* and floodplain residents' understanding the principle of floodplain mapping. First, there is a need to investigate if the floodplain residents had read some of the in-depth contextual analyses on floodplain management policies, particularly on the flood insurance program, which were published several times prior to and following some of the high-magnitude flood events. A follow-up research is needed to answer such specific questions as the respondents' education levels, their subscription of the *La Crosse Tribune*, and their levels of understanding the hydro-technical principles of flood-risk mapping for determining flood insurance premiums. Second, notwithstanding the respondents' understanding of the basic principles of the flood insurance program, it is entirely possible that the assumption of the media role in educating the public about disaster management policies is merely academic when personal finances are involved. During the face-to-face interviews, many respondents complained that they considered the NFIP premium (annual rates of about \$500 for an insured property of \$100,000) to be a tax burden on top of the standard home insurance premium. Although none of the home insurance programs covered flood losses except damages due to sewer backup, the floodplain residents seemed to be unwilling to share some responsibilities for living on the floodplain. Further research is needed to explore this issue, especially in the context of the unintended effect of the federal disaster assistance and other humanitarian disaster relief programs.

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