

# Jean-Marc Zaninetti

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JEAN MARC ZANINETTI

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UNIVERSITY OF ORLEANS

## HUMAN SETTLEMENT AT RISK: THE NEW ORLEANS CASE STUDY

**ABSTRACT.** The aim of this paper is to discuss the causes and consequences of the flooding of New Orleans when hurricane Katrina struck the city on 2005 August 29. New Orleans' site is likely to be flooded during hurricanes, but its vulnerability resulted entirely from unwise urban development. Despite very strong natural constraints, urbanized areas spread into former wetlands between 1945 and 2005. The catastrophe resulted in the displacement of 1.2 million people and extensive damage in Orleans and St Bernard Parish drove thousands of 'environmental refugees' out of New Orleans for months.

**KEY WORDS:** urban sprawl, natural hazard, vulnerability, environmental refugees

### INTRODUCTION

Everyone agrees that the flooding of New Orleans was the worst natural disaster to strike the United States since the great San Francisco earthquake of 1906. So we should examine at first why the flooding has occurred, and why it caused so much damages.

Katrina was the costliest, and the second deadliest hurricane to strike the United States in its entire history. Katrina caused at least 1,800 casualties and more than 116 billion \$ have been spent for hurricane relief in the two years since the storm. In the first instance, we must ask ourselves whether New Orleans was so likely to be flooded, then why its population and businesses were so vulnerable to the hurricane and finally what happened when Katrina occurred.

According to Pierce Lewis (1976), New Orleans grew as 'the impossible but inevitable city'. He adds: 'When one glances at a small-scale map of the United States, it is obvious that there had to be a city at the mouth of the Mississippi

River’, but the River failed to provide any convenient site for its foundation. Mr. de Bienville chose the original site in 1718 for its navigation facilities, but the riverbank of the Mississippi did not offer enough place for a 1-million-person city. If the cypress swamps and the lakes which surrounded the original site offered a strategic protection, they also harboured yellow fever and offered little ground on which to build anything. From its foundation, New Orleans was always under the threat of being flooded, first by the Mississippi River and lately, by hurricanes. According to Craig Colten (2005), the site of New Orleans was literally ‘wrested’ from nature, with an incessant fight against water. Nonetheless, the prosperous port-city of the South grew to an agglomeration of 1 million inhabitants around 1965. At this time, the government of the United States advised that something had to be done in order to protect New Orleans from storm surges.

After studying the likelihood of floods in New Orleans, let us then consider its vulnerability to storm surges, and we shall see finally what demographic effect Katrina had in Southern Louisiana.

### THE LIKEHOOD OF NEW ORLEANS BEING FLOODED

New Orleans’ risk comes from its site characteristics in the Mississippi river delta. From its foundation to 1927, the main threat came from the Mississippi River itself, but this risk was mastered during the 1930s. Unfortunately, the

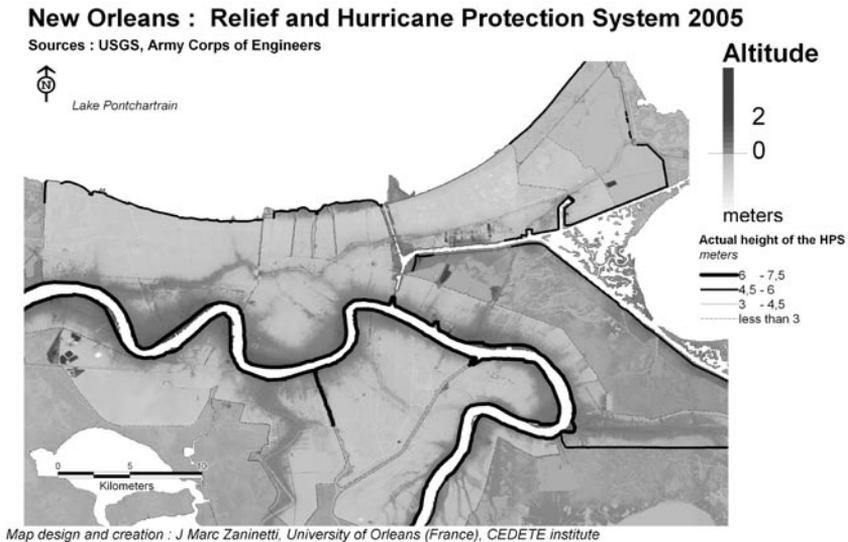


Fig. 1. Site and elevation of New Orleans and its levees

Americans grew overconfident of their mastery over Nature, and the hurricane threat has become the main risk since the 1960s.

New Orleans is under threat of being hit by 1 major hurricane every 19 years. These figures only show the probability, but New Orleans has suffered 5 direct hits by cat.3 or worse hurricanes since the beginning of the 20<sup>th</sup> century: 1915, 1947, 1965, 1969 and 2005. Each of these 5 direct hits caused a storm surge and extensive floods. But the 1915 and 1947 hurricanes flooded mainly marshes and swamps, causing little damage outside of Jefferson Parish. Hurricane Betsy in September 1965 caused more severe floods, but the building of the Hurricane Protection System was just about to begin, and withstood hurricane Camille's surge in August 1969. So, people became confident that they were safe behind the levee's walls, and that they had only 1 'chance' to be flooded in the next 100 years. This is only probability, but most American people are accustomed to making such bets on hazards. That explains why many people did not realize the danger they were in when Katrina was looming over the Gulf and they did not heed the mandatory evacuation order issued by mayor *Nagin* on the morning of August 28<sup>th</sup> 2005, when it became obvious that New Orleans lay directly in the path of the hurricane and that its force peaked to cat.5 on the overheated waters of the Gulf of Mexico. Some had confidence in the living memories of old people who stayed in New Orleans during hurricane Betsy (1965); they believed that the water should not exceed 1m in height at worst. They preferred to stay protecting their homes from burglary considering also that they had not enough time to evacuate in safe conditions, as the failures of hurricane Ivan's evacuation plan showed in 2004. That is the reason why more than 30,000 people were trapped in the city when the disaster occurred.

### **THE HURRICANE PROTECTION SYSTEM AND THE NATIONAL FLOOD INSURANCE PROGRAM**

The Flood Control act adopted by Congress in May 1965 began the building of the Hurricane Protection System (HPS). The USACE was put in charge of the protection of New Orleans against the menace of storm surges. The construction began in 1966. 70% of the cost of raising the HPS was to be paid from federal funds, and 30% had to be funded from local taxes by the Parishes' levee boards. The USACE proposed an initial design of a 200-year flood protection, but the Orleans parish levee board insisted on keeping to the lower 100-year protection, because it was cheaper to build. The USACE proposed to building floodgates at the entrance of the city discharge canals and at the entrance of Lake Pontchartrain (The Rigolets). This 'barrier plan' was discarded in 1977 after the Parishes opposed its construction, because it was too costly for them to build. Raymond

Burby (2006) ‘argues that, the extensive damage in New Orleans and the trend in increasing numbers and severity of disasters are the wholly predictable outcomes of well-intentioned, but short-sighted, public policy decisions at all levels of government. These decisions create two paradoxes. One [he] terms the **safe development paradox**, since [he] shows that in trying to make hazardous areas safe for development government policies instead have made them targets for catastrophes. The second [he] terms the **local government paradox**, since [he] shows that while citizens bear the brunt of losses in disasters, local public officials often fail to take actions necessary to protect them’. In the New Orleans case, the Parishes’ Levee boards insisted on building the minimum protection required to benefit from the National Flood Insurance Program (NFIP) in order to minimize their spending and to maximize their tax base. The NFIP was created by the National Flood Insurance act of 1968. Local governments are required to enforce a Floodplain management ordinance in order to benefit from federally subsidized cheap flood insurance for themselves and their inhabitants. A 100-year flood level of protection is required. In the New Orleans case, the HPS provided the required level of protection. In 2005, the HPS consisted of nearly 200 km of levees of variable height and design and was not fully (40%) completed on the West Bank.

### FROM BETSY TO KATRINA

Katrina revealed severe flaws in the HPS. The misconception began at the beginning of the project. The so-called ‘100-year protection’ was based on 1900–1956 data and an elevation datum of 1927. Betsy’s storm surge was already higher than the designed 100-year reference surge that underlies the entire HPS design. But the design was not changed. The USGS defined a new vertical datum in 1983. The elevation of the whole city was lower than expected, because of the active subsidence of the delta. Subsidence has become a problem in the Mississippi River Delta. About 4,900 sq.km of wetlands have been lost to the sea since the 1930s. An USGS report stressed the fact that 80% of this loss is the result of heavy oil, gas and freshwater extraction from underground, especially during the 1955–1990 period. In the New Orleans area, the average subsidence rate is of 6 mm/yr, and the average sea level rise due to Global Warming is of 2 mm/yr. New Orleans lost more than 0.3 m of elevation from Betsy (1965) to Katrina (2005). Some parts of the HPS, particularly around the Mississippi-River Gulf Outlet (MR-GO) canal built during the 1960s, have lost up to 1 metre or more in elevation.

But congress was reluctant to grant further money to upgrade New Orleans’ protection. Actually, the federal funding of the HPS was cut in half after 2001, despite the fact that scientists demonstrated that a cat.3 hurricane could raise

a storm surge high enough to drown New Orleans (Fischetti, 2001). Actually, the average height of the levees before Katrina was 0.6 meters lower than the designated level. In 2001, FEMA's head said that the flooding of New Orleans was one of the three most likely disasters to affect the United States in the next years. Katrina fulfilled this gloomy prediction.

The so-called '100-year protection' of New Orleans was much weaker than expected, and could hardly withstand a cat.3 hurricane with a return period of 19 years, and the danger worsened with time. So, Katrina's disaster was hardly a surprise, but in my opinion the likelihood of New Orleans being flooded resulted entirely from human choices and actions.

### THE VULNERABILITY OF NEW ORLEANS

One must now question the extent of the damage caused by the onset of Katrina in the New Orleans area. The likelihood of a natural disaster depends on physical geography, but vulnerability depends on human geography. A long-term perspective on the 1945–2005 period illustrates Burby's 'safe development paradox'.

### HURRICANE 'URBAN SPRAWL'

Compared with most American metropolises, New Orleans' population has not grown much in recent decades. Nonetheless, is spreading, and this has resulted in increasing vulnerability to flood risk. Urbanization of the backswamps began after 1927, when the Lake Pontchartrain levees were erected in Orleans Parish. The drainage of these newly protected areas caused the shrinking of the former backswamp's soils, like a drying kitchen sponge. All these neighbourhoods lie at least 0.5 m under sea level. The typical Orleanian settlement consists of semi-detached low-profiled wooden bungalows called shotguns, sometimes raised on a 0.5 m concrete slab. After the 1930's the new affluent Lake Pontchartrain's vicinity neighbourhoods privileged detached Californian style bungalows. The entire area consisted of a majority of one-storeyed buildings, which proved entirely vulnerable to flooding after Katrina. Hurricanes Betsy (1965) and Camille (1969) pointed out the danger of these urban developments, but the HPS (1965) and the NFIP (1968) counteracted the risk to satisfy the demand for affordable individual housing. From 1970 to 2000, the number of households within the limits of the HPS increased by +31%, almost entirely at a distance of 15 kilometres or more from New Orleans' City Hall.

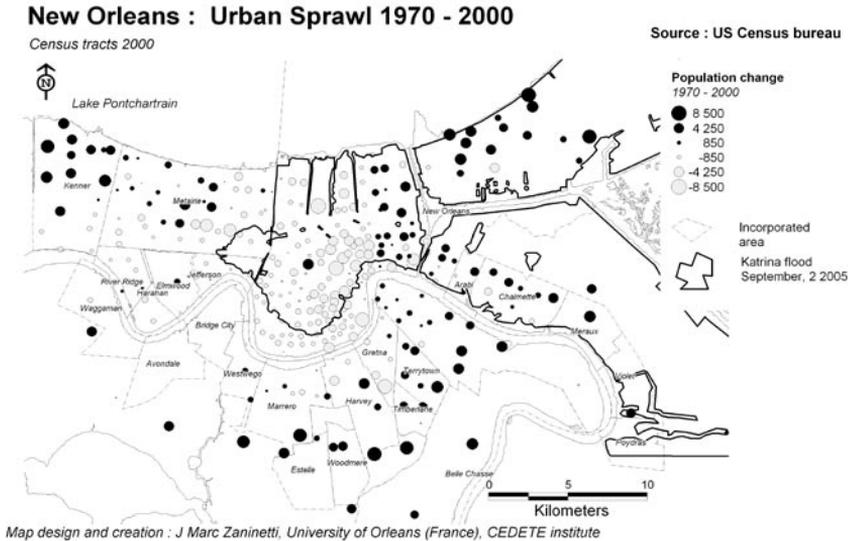


Fig. 2. Urban spread 1970–2000

One half of the households (150,000) were situated below sea level in 1970. The figure rose to 222,500 in 2000, +50% vs. +12% only on higher ground. From Camille (1969) to Katrina (2005), the population living below sea level inside the HPS boundaries increased by 92,070 (+18.5%) when the total population of the area increased by 62,624 only (+6.5%). The share of population living below sea level rose from a 51% figure in 1970 to 57% in 2000, with a nighttime population of 588,218 people living in low-lying neighbourhoods.

### RACES AND POLITICS, THE CAUSES OF SPRAWL

A much-discussed problem in the United States is that of urban polarization between blacks and whites, forming two nations, ‘separate and unequal’ (Kerner report 1968). Through lack of space, and until WWII, New Orleans was poorly segregated, despite Blacks forming 30% of the total population. Each block tended to develop an affluent white perimeter along the boulevards and a poor black core. But congress subsidized the building of East Bank Jefferson and St Bernard Parish levees after the 1947 hurricane. According to Lewis (1976), the Supreme Court’s *Brown vs. Board of Education’s* order to integrate schools (1954) triggered a sudden wave of white flight out of Orleans Parish. From that time to 1980, the city simply exploded into the swamps and grew more segregated. Orleans parish’s population peaked in the 1960 census, with

a 627,500 figure, including 37% of blacks. Then, the central city downsized to an estimated number of 452,000 inhabitants before Katrina, less than its 1930 level. More than 67% of the 2000 census population is black. Suburban Jefferson Parish's population rose from 50,000 in 1940 to 455,000 in 1980, 14% of whom were black residents. Suburban St Bernard Parish's population rose from 7,000 in 1940 to 65,000 in 1980, less than 4% of them being black residents only.

### GOVERNANCE ISSUES

Since 1980, the total population stabilized inside the HPS limits, the continued growth of the fringes (particularly West Bank Jefferson) being compensated by the decline of the central city. Urban sprawl leaped north of Lake Pontchartrain into St Tammany Parish, following the construction of the Lake Pontchartrain Causeway in 1956 and of the Interstate I-10 freeway in 1958. St Tammany Parish's population grew from a 38,650 figure in 1960 to 191,268 in 2000, 10% of whom were black residents.

In the words of David Rusk, 'One of the most striking findings of my study was that from 1950 to 1998, or 48 years, urban sprawl – 'Hurricane Sprawl', if you will – wiped out over half of the City of New Orleans' property tax base. In 48 hours, did Hurricane Katrina destroy more than half of New Orleans' remaining commercial, industrial, and residential property? Not likely. 'Hurricane Sprawl' devastated New Orleans more than Hurricane Katrina'.

Urban sprawl and the white flight left New Orleans city much impoverished. The average per capita income was only 85% of the federal mean in 1999. The poverty rate was high: 28% of Orleans parish's population vs. a 13% figure only in the suburban parishes and a national rate of 12%. This poverty resulted in a poor tax base for the city and the county's authorities, including the Orleans Parish Levee Board, which was in charge of the maintenance of the levees on its territory. I am of the opinion that it was no chance if the levees failed in 4 spots exclusively in Orleans Parish.

### KATRINA'S AFTERMATH

Hurricane Katrina resulted in massive levee failures and in the long-feared flooding of most of East Bank New Orleans and St Bernard Parish. Nearly 3 out of 4 disaster victims were blacks. Mayor Nagin issued a mandatory evacuation order only two days before the landing of the hurricane and no buses or trains were made available for the evacuation of the elderly, the sick or the poor lacking transportation stranded in the city. The 'last resort shelter' of the Superdome proved to be an inferno and the Convention Center shelter was but a sinister hoax.

The floods resulted in an immediate blackout and a massive communications failure and first aid collapsed, being caught between contradictory orders issued by the FEMA, the Army, the state of Louisiana and the City of New Orleans. The chaos reached such a magnitude that one week was lost in securing about 30,000 people out of the inundated city. Katrina's aftermath has created anger and frustration among Orleanians, particularly in the African-American Community. The hurricane resulted officially in 1,527 casualties in Louisiana, but there are still some missing people left. Katrina is the costliest natural disaster in the history of the United States. In the first two years after Katrina, the bulk of the 116 billion \$ of money spent for hurricane relief went to personal aid, of which 75 billion \$ has been spent for emergency relief.

After Katrina, 3 weeks were needed to pump the water out of the city and fix the main breaches in the levees. Hurricane Rita added a further 2-week delay before the city was finally reopened to residents. The first problem was to dry the city and make it safe for residents. For instance, St Bernard parish was evacuated in October 2005 because of chemical pollution caused by an oil spill out of a flooded refinery. The second task was to restore power, and that was not effective in some parts of the city for 6 months because of the bankruptcy of the local electricity company (*Entergy*). This slowed down the return of the residents, and the curfew was lifted only in April 2006 in East New Orleans. One full year was needed to restore the existing HPS. All flooded homes had to be gutted before any reconstruction. Structures unfit for habitation had to be torn down, and the demolition process is still under way through lack of money. Debris removal is still unfinished for the same reasons, and because of the further problem of a shortage of safe storage space locally. The cleaning up of New Orleans is still underway and the entire population has not returned yet. Help has focused on helping homeowners. The State of Louisiana ran the 'Road Home program' with federal money. Payments began in January 2007. In a few months, 180,000 applicants asked for help, causing a reduction in the actual help from its designated average of 91,000 \$ per housing unit to a 68,000 \$ average.

## THE DEMOGRAPHIC IMPACT OF THE HURRICANE

Katrina had a large immediate demographic impact. The FEMA had to help more than 2.5 million Katrina – Rita applicants. Around 600,000 refugees (45% of its current population) had fled the New Orleans metro area in October, among them 68% of the total population of Orleans Parish (300,000), where 80% of the housing units had suffered flooding, and 95% of the population of St Bernard Parish (60,000). The FEMA provided refugees with a replacement income for 8 months (from October 2005 to May 2006). At the beginning of the year 2006,

the St Bernard Parish had been emptied of its entire population, and Orleans Parish lacked 64% of its population. The recovery rate was very slow in these two blighted areas. The other Parishes of the metropolitan area were less hard hit. According to the US census bureau estimates, Plaquemines Parish had lost 28% of its total population (8,000) between July 2005 and January 2006, and 8% of its inhabitants had left Jefferson Parish (35,000). The total number of refugees was still of 372,500, 29% of the total metro area's population 4 months after the disaster.

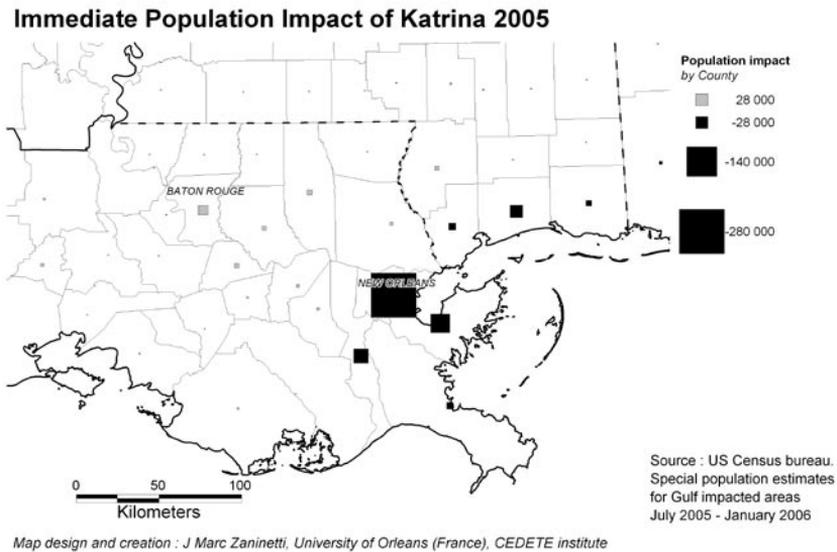


Fig. 3. Immediate impact of Katrina

One year after Katrina, 278,000 people were still displaced out of the New Orleans Metro Area, 22% of the 2005 population, 97% of these refugees having lived formerly in Orleans Parish or in St Bernard Parish.

Two years after Katrina, St Tammany and Jefferson Parishes have fully recovered, and Plaquemines Parish has bounced back to near its pre-Katrina population level. St Bernard Parish has lost 2/3 of its former population. After 6 months of basic infrastructure restoration, homeowners came back to gut their damaged homes and apply to the 'Road Home program'. But a majority of them did not plan to stay and a wave of panic sales began in the summer of 2006, causing the local housing market to collapse. The population recovery slowed down in the second year after Katrina and the local housing market showed few signs of revival.

Orleans Parish's population recovery went very slowly. 1 year after Katrina, the total population of the City was estimated to be less than 50% of its pre-Katrina level. 65% of the white residents returned during the first year, but only 30% of the black residents. The housing shortage and the resulting high rents was the first cause of this difference; the second cause lay in the fact that the African-American community lived mainly in the most heavily damaged neighbourhoods before Katrina (Lower 9<sup>th</sup> Ward, Gentilly, East New Orleans). Poor renters cannot simply afford to rent a flat in New Orleans. Poor homeowners, 40% of whom being uninsured before Katrina, do not have the money required to fix their devastated house. Two years after Katrina, the estimated population has reached only 66% of its pre-Katrina level. The housing market seems stabilized, and the city is bouncing back to normal. However, eastern neighbourhoods remain largely emptied of their inhabitants and northern neighbourhoods have recovered only a small part of their former population.

### CONCLUSION: IS NEW ORLEANS STILL A SUSTAINABLE CITY?

Katrina has raised public awareness to a high level, and American opinion has moved to more favourable views on such issues as urban and regional planning and coastal protection and restoration. After a difficult first year, one can observe much initiative at every level of government towards a more sustainable settlement pattern in southern Louisiana able to address the issues raised by the 2005 disaster. According to a 2006 survey, 93% of Louisiana's resident population support implementation of the state's coastal restoration and protection plan. 88% support the idea that reducing community risk should prevail over property rights, and 81% want to change land use and development patterns. Urban and Regional plans follow the guidelines of Congress for New Urbanism: they emphasize transit oriented development, increased density and land-use regulation. In the southern United States, it is a cultural revolution! In my opinion, we are witnessing a milestone on the long road the United States of America has to follow towards sustainable development. An unprecedented effort of regional planning including innovative environmental engineering is underway.

Finally, the question is to know whether this plan is bold enough to address the issue of global change. Scientists expect an average sea level rise of 1.1 m in the next century, provided no large continental ice cap melts. Most of southern Louisiana lies actually below 1 metre in elevation above the sea level, and 80% of the New Orleans urbanized area lies below the current sea level. The Mississippi delta is sinking and the sea level is rising. Can the Mississippi delta escape submersion? This dilemma can be compared to the Netherlands.

Louisiana is now turning its attention to the Dutch model of long term planning and regularly funded projects instead of the typical American short-term savings, which proved disastrous with Katrina. The need for integrated planning on the scale of the entire Mississippi watershed is another lesson of the Dutch experience. This needs further steps from the present federal policy, which still adheres to a shortsighted and immoral disaster business model. Now, let us pray for the adequate funding of all these new planning initiatives, and hope that no hurricane similar to Katrina will occur until the achievement of the upgrading of the HPS in 2011.

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**CORRESPONDENCE TO:**

Jean Marc Zaninetti  
Université d'Orléans  
UFR Lettres, Langues et Sciences Humaines  
10 rue de Tours, BP 46 527  
F – 45 065 Orléans cedex 2, FRANCE  
e-mail: [jean-marc.zaninetti@univ-orleans.fr](mailto:jean-marc.zaninetti@univ-orleans.fr)