
Research article

Perceptions of gentrification after a climate disaster: An example from Hurricane Florence

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Abstract: Natural hazards, particularly hurricanes, cause extensive flooding, resulting in billions of dollars in losses to coastal communities, affecting people and infrastructure. Over time, as socioeconomic patterns shift, the impacts of hazards also shift and change the landscape. While much of the literature entails the structural and economic aftermath of natural hazards, fewer researchers explore their role in shaping neighborhood gentrification, especially from residents' perspectives. Through a community survey, residents' perceptions were examined to identify how Hurricane Florence (September 2018) influenced neighborhood changes throughout coastal New Hanover County, North Carolina. Using a community survey questionnaire, we identified several factors that influence the perceptions of gentrification. Multivariate regression identified several significant relationships between residents' perceptions of the impacts of natural hazards, specifically Hurricane Florence (the dependent variable), their residential status (renter/owner), education level, household income, perceived neighborhood changes in the past five years, and disaster recovery policies. These findings suggested that while many respondents recognized characteristics of gentrification, such as increased housing development and rising living costs, opinions on the role of Hurricane Florence in this process were divided. This study contributes to the growing literature on the impacts of natural hazards on gentrification processes and emphasizes the importance of understanding community impacts following natural hazards through the eyes of residents.

Keywords: natural hazards; gentrification; disaster recovery; hurricanes; resident perceptions

1. Introduction

Disasters occur when a natural hazard affects a community and typically cause infrastructure and property damage, economic devastation, and loss of life. Extreme weather events, notably tropical cyclones and hurricanes, have intensified in frequency and severity, resulting in subsequent flooding that poses significant challenges to community well-being, particularly in coastal regions. Hurricanes can cause significant damage to coastal communities, including physical damage to infrastructure and homes, displacement of residents, disruptions to critical services such as healthcare and transportation, and economic losses resulting from business closures and job losses [1]. These impacts can be particularly severe in low-lying areas, where flooding and storm surges can cause extensive damage. Additionally, coastal communities may be at greater risk of hurricane impacts due to sea-level rise, erosion, and climate change [2].

Communities face numerous challenges in the aftermath of natural hazards, including limited access to resources and support services, inadequate emergency preparedness plans, ineffective communication channels, and insufficient infrastructure to withstand the disaster's impact [3]. In many cases, these challenges also disproportionately affect marginalized and vulnerable populations [1].

Studies have shown that in the wake of rebuilding from disasters, these more vulnerable communities are left behind and displaced, causing their previous homes to become gentrified [4]. Attention to racial and income disparities in flood resiliency has highlighted systemic bias resulting from historic land-use practices in the United States, including redlining, property values, and insurance rates [5,6]. Since communities that are more vulnerable to hurricane damage also lack the resources to deal with the natural hazard's aftermath, recovery takes longer. This can lead to displacement or financial struggles, rendering the area a prime target for gentrification [7].

Gentrification can cause a community to undergo a cultural shift and decrease socioeconomic diversity, infringing on the area's original identity and history [4]. Research has also revealed that flooding events contribute to "climate gentrification", where higher-income households drive up demand and property values in safer areas, leading to sociodemographic shifts in urban areas [8,9]. While the immediate economic impacts of flooding affect all communities in its path, the long-term consequences are particularly severe for economically vulnerable populations. As a result, flood-related impacts are often linked to environmental injustice, disproportionately weakening the socioeconomic resilience of low-income households [10–12].

The literature on the impact of natural hazards on gentrification primarily entails New Orleans, Louisiana, following Hurricane Katrina in 2005 [13–15]. Moreover, most researchers on gentrification and disasters have based their research on census data by measuring a census tract's susceptibility to gentrification [9,13,14]. Additionally, research using census data often examines neighborhood changes at the census tract level; however, these tracts do not always align with local residents' perceptions of their neighborhood [16,17]. There is limited research in the literature on the relationship between natural hazards and gentrification, particularly in terms of perceived visible

cues and residents' perceptions. Furthermore, even fewer researchers have compared the impacts of hurricanes on vulnerable populations in southeastern North Carolina [18] or the effects of gentrification and migration processes post-storm [19].

To fill these research gaps, in this research, we focus on: 1) understanding residents' perceptions of how Hurricane Florence and its aftermath may have impacted their neighborhoods, as well as the perceived gentrification in New Hanover County, and 2) identifying factors that may impact residents' perceptions of the impacts of natural hazards on the gentrification process.

Based on the discussion above, the following research questions (RQs) guide this research:

- *RQ 1: What are residents' perceptions of neighborhood changes and the impact of natural hazards (e.g., Hurricane Florence) on the gentrification process, if any?*
- *RQ 2: What factors may impact residents' perceptions of the impacts of natural hazards (e.g., Hurricane Florence) on the gentrification process?*

1.1. Gentrification in the context of natural hazards

Gentrification occurs when a lower-income community or a plot of land in an undeveloped area is transformed to attract the middle and upper classes for commercial, residential, or recreational use. Gentrification can occur relatively quickly or more gradually over time, progressing through stages, depending on the circumstances. Typically, gentrification results in the displacement of the population that previously resided in the area [20]. With these displaced families and individuals no longer present, the community can undergo a cultural shift and decrease socioeconomic diversity, infringing on the original community's history and identity [4].

The impact of natural hazards further accelerates the gentrification process by putting a strain on vulnerable populations. The damage from natural hazards is never evenly distributed, and neighborhoods with lower socioeconomic status tend to be disproportionately affected compared to those with better infrastructure, access to resources, and financial stability. Since communities that are more vulnerable to hurricane damage also lack the resources to deal with the natural hazard's aftermath, recovery takes longer. This can lead to displacement or financial struggles, rendering the area a prime target for gentrification [7]. Therefore, these highly vulnerable communities are stuck in these hazard zones [8]. Additionally, the intensity level of a hazard impacts neighborhood change. A low- or average-intensity natural hazard has no noticeable effects on neighborhood change, such as gentrification, whereas large-scale hazards significantly change neighborhoods [16]. Lee [16] found that high-income neighborhoods are more likely to recover financially and return to their previous state on their own. In contrast, low-income communities often struggle to afford repairs or rebuilding, resulting in rapid decline and deterioration.

Another common phenomenon accelerating gentrification in the wake of natural hazards and disasters is "disaster capitalism". Disaster capitalism occurs when the government or economic elites attempt to capitalize on disasters, whether they be social struggles or significant natural events. Disaster capitalism tends to exploit vulnerable populations while they are still shocked by recent events [21]. These vulnerable populations experience a prolonged period of psychological displacement since the disaster is integrated into the present-day economic environment surrounding them [21]. Disaster capitalism can be utilized by political officials, developers, tourism industries, or

a combination of various actors. In most cases, these opportunities are taken up by more powerful influencers who aim to maximize personal gain, undermining local efforts and populations in hopes of recovering and forgetting the traumatizing past [22]. As the area's industry builds on the disaster publicity, the area's identity can shift, altering the image and culture once associated with the area's pre-disaster state and community [23]. A prominent example of disaster tourism can be found in Thailand following the 2004 Indian Ocean tsunami, where tourism development plans were proposed shortly after the disaster, and recovery aid was only provided if residents relocated [24]. This event is defined as strategic land grabbing in which governments evict residents from their land either through policy or under the guise of rehabilitation [25].

1.2. Perceptions of gentrification and its impacts

Researchers analyzing gentrification and natural hazards have used census data to identify gentrified census tracts or measure a census tract's susceptibility to gentrification [9,13,14]. The analysis by Aune et al. [14] revealed that census tracts susceptible to gentrification had a higher ground elevation, lower flood depths from Katrina, and a higher likelihood of transitioning from a majority African American population to a majority White population. Aune et al.'s [14] findings supported those of research conducted in Miami, Florida, focusing on climate gentrification and the effects of climate change on flooding and sea-level rise [9]. Keenan et al. [9] found that social gentrification (seen through an increase in education and income levels of a given area) is more likely to occur in higher elevation areas. Hwang and Sampson [26] pointed out that some census tracts could be incorrectly correlated with gentrification when looking only at census indicators and highlighted the importance of visible cues for gentrification. Building on the research of Hammel and Wyly [27], Hwang and Sampson [26] used Google Street View to examine census tracts in Chicago that had been identified as gentrified, assessing how gentrification had progressed since 1995. By coding street-level images from randomly sampled blocks within these tracts, they analyzed the continued evolution of gentrification over time.

Hwang and Sampson [26] also addressed how residents' perceptions of variables such as disorder and crime, commonly associated with poorer minority neighborhoods, deterred gentrification. For example, visible disorders (e.g., graffiti and vacant lots) are perceived as less attractive to potential gentrifiers and are considered undesirable for reinvestment. This conclusion supports their theory that neighborhood stigmas can influence neighborhood change and renewal [26]. Hwang and Sampson [26] also found that Black and Latino neighborhoods often experience gentrification that is distinctly different from predominantly White neighborhoods. In Black and Latino communities, gentrification is likely to result in the economic and social marginalization of existing residents. In contrast, residents of predominantly White areas may benefit from neighborhood renewal without facing displacement threats.

Residents' income level impacts how they view gentrification processes. Owens et al. [28] discovered that lower- and middle-income individuals were more likely than higher-income individuals to view gentrification negatively. Individuals who experienced increased financial struggles compared to those with more stable or improved financial situations perceived gentrification as negative [28]. Moreover, Pattillo [29] explored the perceptions of Black residents' viewpoints on gentrification in Chicago neighborhoods. She found that higher-income and middle-income Black residents generally perceived gentrification more favorably than lower-income residents, as they often

appreciated the improvements in neighborhood safety and infrastructure. Low-income Black residents viewed gentrification as a threat to their community and feared rising rent costs and potential displacement [29]. This is a similar finding to Owens et al. [28], who found that low-to-middle-income Black residents perceived gentrification in a negative light compared to higher-income Black residents.

Antunes et al. [30] found similar results regarding neighborhood perceptions of gentrification through 36 semi-structured interviews with residents and business owners in the gentrifying neighborhood of Vallcarca, Barcelona, Spain. Antunes et al. [30] found that gentrification processes are associated with a rise in rent, the construction of higher-income housing, and an increase in high-rise buildings. Areas perceived to be most susceptible to gentrification were areas with large amounts of vacant lots. Their results also showed that owners were more likely to perceive gentrification processes than renters, and anti-gentrification struggles were recognized more by younger adults than residents 60 years and older [30]. Freeman et al. [31] also found that rent increased, as did the probability that renters would relocate.

Gender has also been linked to differences in perceptions of gentrification. Women experiencing gentrification are often those who are underprivileged and have been historically marginalized. Many individuals work in low-wage jobs and face economic and housing instability, making them particularly vulnerable to gentrification pressures [32]. Additionally, women face greater challenges accessing recovery resources in areas recovering from natural hazards [33]. As a result, relocation may be particularly challenging or even unattainable for many women.

Education level is another factor that may influence how individuals perceive gentrification and its effects. Owens et al. [28] found that individuals with higher educational attainment view gentrification as “bad” and perceive it as having no benefits to them. However, since education level is often tied to income, those with higher educational attainment are also likely to be more financially stable and can avoid displacement, as well as reap the benefits of gentrification processes, such as rising land and property values [34]. Typically, individuals with higher levels of education are often the newcomers moving into gentrifying neighborhoods [35]. Additionally, individuals with lower education levels have higher exit rates from gentrifying neighborhoods, especially residents who are Black or Latino [36,37]. Tying residential perceptions and gentrification to natural hazards, Adams et al. [37] examined perceptions of racism associated with Hurricane Katrina's pre- and post-storm events, including evacuation and recovery. Many New Orleans residents expressed concerns that racism influenced Katrina rebuilding plans and that authorities would use the hurricane as a natural demolition force and take the opportunity to gentrify the area [37].

1.3. Subjective experiences and perceptions of post-disaster recovery and quality of life

There are many definitions of Quality of Life (QoL) from various disciplinary perspectives, but in the resiliency domain, QoL is conceptualized as being maintained, disrupted, or transformed after a disaster event [38]. QoL can be defined using social indicators, subjective well-being measures, and economic indices [39]. Additionally, there are several methods for estimating or quantifying QoL, such as geospatial data analytics using the US Census data and qualitative measures of QoL using population surveys [39]. The latest peer-reviewed research shows a methodological shift from narrow clinical health-related metrics toward holistic, multi-domain qualitative evaluation tools and population

surveys. Instead of viewing QoL from traditional health or economic perspectives, contemporary studies use qualitative community feedback to understand residents' perceptions of QoL, which is especially important after disasters when recovery policies and rebuilding efforts are interpreted and experienced differently by individuals. Scholars increasingly emphasize that disaster recovery is not only a process of rebuilding infrastructure, but also a subjective process shaped by individuals' perceptions, aspirations, and interpretations of well-being and QoL [40]. This personal perspective of QoL aligns with post-disaster research on resiliency, which emphasizes the importance of policies that incorporate local perspectives.

QoL perception studies have identified resiliency needs that vary by socioeconomic status. For example, Raker et al. [41] analyzed surveys and in-depth interviews with low-income mothers impacted by Hurricane Katrina and concluded that "achieving normalcy" is a crucial component in an individual's recovery. What participants defined as "normal life" is subjective, but most often characterized by the restoration of fundamental needs, such as stable housing, employment, and satisfaction with their neighborhood. These findings reflect a broader understanding of recovery as the re-establishment of basic conditions necessary to maintain a minimum QoL for low-income women. Raker et al. [41] also found that individuals who had experienced greater amounts of home damage or several traumatic events were less likely to return to "normal", which impacts their perception of long-term recovery. Physical damage to a home is a consistent perception of QoL, and the damage is directly related to the sense of place [42]. Researchers highlight that "place-based" stability is crucial for understanding how people are affected by disasters and for defining their perspectives on the recovery process [42]. However, place-based stability can be impacted by gentrification processes [42]. From a well-being standpoint, gentrification is not only a physical transformation, but also a process that can undermine residents' ability to meet basic needs and recover to a sense of "normalcy" [42,43]. Therefore, the perception of QoL is directly linked with the process of recovery and gentrification.

Research has shown that residents of lower socio-economic status who are not physically displaced from their neighborhood can feel socially isolated when gentrification results in the loss of familiar social identity, local community resources, and long-term neighbors [42,43]. QoL depends on continued occupancy of a place, including economic practices, cultural and religious memberships, and personal relationships [43]. Conversely, when a disaster results in displacement where residents are removed from their familiar long-term location, it not only impacts their QoL, but also impacts their employment due to accessibility constraints and educational detriment to children. Rising costs, shifts in employment opportunities, loss of services, and disruptions to personal relationships all affect an individual's QoL [43]. Therefore, residents' perceptions of post-disaster changes are subjective and based on experiences and expectations associated with their neighborhood, highlighting the importance of considering how individuals interpret places and transformations following a disaster [44].

Other researchers have investigated the linkage between personal QoL and community identity following a disaster. Prayag et al. [45] conducted in-depth interviews and found that re-establishing a sense of community and belonging is vital in supporting resilience post-disaster. Increased social capital through bonding with people with similar lived experiences and through linking ties to those in formal institutional or government roles played a large part in individuals' ability to re-establish their well-being. Specifically, post-disaster social capital, as measured by linking neighborhood ties, was shown to be important for long-term community revitalization [46]. Therefore, if individuals do not

feel connected to their community or supported by their local government after a disaster, their recovery will likely be perceived differently. Prayag et al. [45] concluded that hazards transform a place and gentrification can produce long-term community changes, which can alter a person's sense of place and perceptions of QoL post-disaster.

Overall, these findings highlight how residents' perceptions of stability, belonging, and neighborhood change, including gentrification, impact perceived QoL, and the evaluation of disaster recovery efforts. Post-disaster recovery is explicitly tied to residents' ability to maintain QoL by fulfilling basic material, social, and psychological needs. Neighborhood change, such as gentrification, can disrupt the QoL recovery process in housing, social networks, and community resources and services, particularly among lower-income and socially vulnerable populations [43,45]. Residents' subjective interpretations are particularly relevant in places where post-disaster redevelopment intersects with gentrification.

The rise of gentrification in the wake of natural hazards is becoming a more widely discussed environmental issue; however, research has focused on quantitative data analysis, not residents' perception of QoL and neighborhood change. Many QoL studies, although informative, have not adequately reflected how people feel, and satisfaction with life may change depending on experiences and events [39]. Additionally, few researchers have investigated the relationship between perceived gentrification and residents' QoL. We fill the research gap by examining perceived neighborhood change post-Hurricane Florence in 2018.

2. Materials and methods

2.1. Study area

Carolina Beach, Wilmington, and Wrightsville Beach are nationally known tourist destinations within NHC, North Carolina. Research on climate vulnerability shows that areas in New Hanover County (NHC), North Carolina, such as Carolina Beach, suburban Wilmington, and Wrightsville Beach, rank high in physical and social vulnerability to inundation [18]. According to an economic impact study, domestic visitors to and within NHC spent nearly \$598 million in 2020 [46]. NHC has a sizeable economic reliance on coastal resources and a wide range of socio-economic classes. Based on the American Community Survey's 2020 five-year estimates, 44% of the NHC population has a median household income of under \$50,000 annually [47]. Conversely, 7% of the NHC population has a median household income of over \$200,000 annually [47]. NHC also has characteristics in terms of vulnerability, beyond hurricanes. According to Justice40, a White House initiative to direct federal investment into disadvantaged communities, there are 13 disadvantaged tracts in NHC [48]. These disadvantaged tracts share commonalities in low rankings across categories, including affordable and sustainable housing, climate change, clean transit, reduction and remediation of legacy pollution, health burdens, and training and workforce development [48].

Hurricane Florence is ranked the 12th costliest tropical cyclone to impact the United States [49]. When Florence landed in Wrightsville Beach in 2018, it took nearly two days to pass over North Carolina and up the coast [2]. Florence made landfall in North Carolina as a Category 1 storm, claiming 30 lives in the state while leaving nearly \$24 billion worth of flood damage in its wake [50]. In 2020, federal and

state assistance programs provided \$2 billion for recovery efforts to North Carolina communities, including disaster loans and flood insurance payments for Hurricane Florence survivors [51].

2.2. Survey design and distribution

A Vulnerability Rank Index (VRI) was computed using ArcPro and 2020 Census data at the Block Group (BG) level of geography. Variables incorporated in the VRI were based on the gentrification research of Van Holm and Wyczalkowski [7] and Antunes et al. [30] who used demographics and housing to characterize vulnerability. The 2020 ACS 5-year data tables were downloaded from the US Census Bureau, joined with the BG geography, and converted from raw data to standardized variables (Table 1). Next, the standardized variables were ranked into three groups using a quantile method, where each group had an equal number of BGs. The VRI was calculated as the sum of the variable ranking, with higher ranks indicating higher vulnerability characteristics in the BG.

$$\text{Final VRI} = \text{Total Rank} - (\text{Minimum Rank} - 1).$$

Table 1. Demographic Variables Included in The Vulnerability Rank Index Variable Number.

	Variable Description (standardized)
1	Non-White (percent)
2	Age 17 and under (percent)
3	Age 70 and greater (percent)
4	Population Density (people/BG)
5	Families below poverty level (percent)
6	Families with Single-Headed Household (percent)
7	High School Education (percent)
8	Median Household Income (z-score)

The distribution of VRI identifies BGs that have higher and lower population vulnerability is shown in Figure 1.

The VRI was used to create a weighted survey distribution and based on the work of Antunes et al. [30], Hwang and Sampson [26], and Sullivan [52], who conducted gentrification perception studies in Spain, Chicago, and Oregon, respectively. For this research, survey questions were aimed at collecting information about respondents' experience with Hurricane Florence (if any), perceptions of change within their neighborhood, familiarity with gentrification (using a 5-point Likert scale), and general demographics about the respondent. There was also an open-ended question for any final thoughts or comments that a respondent may not have been able to relay through the questions. All questions related to gentrification were saved for last, not to sway respondents' initial answers. A definition of gentrification was also provided. This survey and its distribution methods were approved by the University of North Carolina Wilmington (UNCW) IRB (H23-0486).

Funding was available to print and mail 5,000 postcard surveys. The goal was to mail more postcards to BGs with higher VRI values. To determine the number of postcards mailed to each BG, a weighted stratified sampling technique with linear rank weights was used. A baseline number of

samples/BGs was calculated from the number of postcards (5,000) divided by the number of BGs in the study area (151), which is 33. From this, a weighted survey was computed using the VRI. This enabled us to give higher weights to more vulnerably defined block groups:

Equal number of surveys = 5,000 Postcards / 151 Block Groups = 33;

Weighted Survey (per BG) = $33(\text{VRI} - 1)$.

The results showed a disproportionate allocation of surveys favoring block groups ranked higher on the VRI.

Survey / BG = $(5000 \times \text{Block Group Weight}) / \text{Sum of All BG Weights}$.

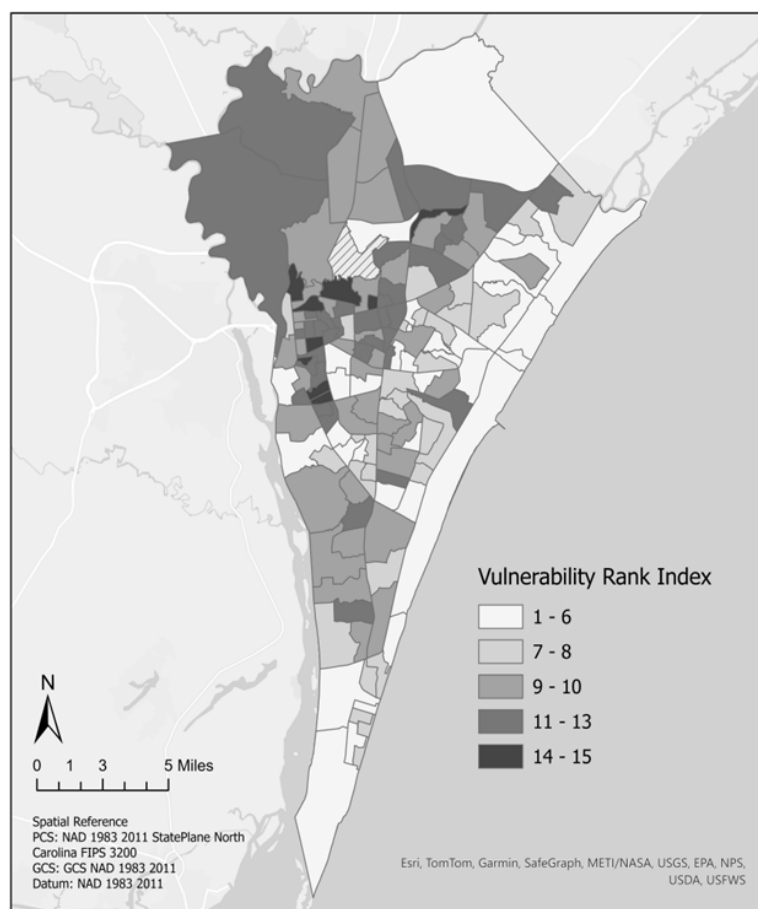


Figure 1. Vulnerability Rank Index (VRI) at the Block Group (BG) level of geography. Note: the BG that has no VRI is the Wilmington International Airport and therefore has no population.

The New Hanover County tax department provided a list of the county's housing records. These housing records contained addresses, which we linked to their associated block groups in ArcGIS Pro. Once addresses had an associated Block Group code, the table was exported in Excel. Resident addresses for surveying were randomly selected in Excel using the random number generator function. The number of randomly selected addresses in each Block Group corresponded to the number determined by the disproportionate stratified sampling technique based on the VRI ranks.

The postcard included a brief description of the project, the survey link, and a QR code directing each recipient to the online Qualtrics survey. Recipients were able to complete the survey online by using the survey link, scanning a QR code, or they could request a hard copy of the questionnaire. Due to the limitations of funding and mailed surveys, the survey was also made available to the public to help increase the response rate. The survey was advertised on Facebook, Instagram, and LinkedIn, as well as at several in-person events through various public pages and community groups, including the Cape Fear Housing Coalition, City of Wilmington, and NHC Health and Human Services, among others. The survey began collecting responses initially on May 22, 2023, through mailed postcards, and was then opened to the public on social media. The survey stayed open until September 2023.

Across the combined data collection methods, we obtained a total of 155 responses. Since all questions in the survey were voluntary, some respondents left a few questions unanswered. Missing rates for key variables range from 0 to 19%. A listwise case-exclusion approach was applied when performing the regression analysis. Since we opened the survey to social media to help increase response rate, we were unable to determine how many individuals we reached, which prevented us from calculating the exact response rate; however, we estimated the response rate to be between 2–3%.

2.3. Data analysis

All statistical analyses were performed using SPSS 28. We utilized descriptive statistics to address RQ1 (*What are residents' perceptions of neighborhood changes and the impact of natural hazards (e.g., Hurricane Florence) on gentrification process, if any?*), and a multivariate regression analysis to address RQ2 (*What factors may impact residents' perceptions of the impacts of natural hazards (e.g., Hurricane Florence) on the gentrification process?*).

Multivariate regression analysis assumes that: (1) The dependent variable is directly related to the independent variables (linearity); (2) for any two observations in the dependent variable the residual terms should be uncorrelated (independence); (3) the data are normally distributed (normality); (4) there should be no direct relationship between two or more of the independent variables (multicollinearity); and (5) the variance of the residual terms should be the same at each level of the independent variables (homoscedasticity) [53]. The Durbin-Watson test determines whether adjacent residuals of the outcome variable are correlated. The Durbin-Watson test statistic ranges from 0 to 4, with values less than 1 or greater than 3 raising concern [53]. The Durbin-Watson value of our model was 1.823, which was within the acceptable range, indicating independence of observations among residual terms in the dependent variable. The variance inflation factor (VIF) indicates whether an independent variable is strongly related to the other independent variables [53]; if the maximum VIF exceeds ten, this indicates a serious problem [53].

3. Results

3.1. Descriptive statistics

Descriptive summary statistics of the 155 respondents in comparison with the overall New Hanover County population are shown in Table 2. Most (62.3%) respondents were in the 35–74 age

range, with the largest number of respondents in the 35–44 age category (18.8%). More than 60% of respondents were female (61.7%), and most respondents were White non-Hispanic (86.4%). The most common response to the highest level of education was a 4-year degree (47.6%), and most respondents own their current housing (69.4%). Total annual household income before taxes had a wide range, but most were within the \$50,000–99,999 range (32.6%), and within this range, the largest percentage of respondents were in the range of \$50,000–69,000 (19%). Our survey sample respondents were more likely to identify as White, middle-aged, and college-educated, and reported higher household income (Table 2).

Even though the survey return rate was small, the demographics were similar for median household income and age group. There were some slight demographic skews when compared to the overall county population. For example, our respondents identified more White, more female, and more educated than the demographic breakdowns of New Hanover County population. Therefore, we cannot generalize in a strict statistical sense, but the survey results can provide important insights into residents' perceptions.

Table 2. Descriptive summary statistics comparing Resident Surveys with New Hanover County (U.S. Census Bureau American Community Survey 1-year estimate, 2024) [54].

Demographic	Sample (N = 155)	New Hanover County (N = 238,852)
Median Age	35–44 (18.8%) 45–54 (13.6%)	30–39 (12%) 40–49 (12%)
Gender		
<i>Male</i>	55 (35.7%)	48%
<i>Female</i>	95 (61.7%)	52%
<i>Other</i>	4 (2.5%)	–
Race		
<i>White</i>	133 (86.4%)	170,837 (71.5%)
<i>Black</i>	12 (7.8%)	27,386 (11.5%)
<i>Hispanic or Latino</i>	2 (1.3%)	17,300 (7.2%)
<i>American Indian and Alaska Native</i>	4 (2.5%)	1,038 (.4%)
<i>Asian, Native Hawaiian, Other Pacific Islander</i>		3,669 (1.5%)
<i>Other Races</i>		8,128 (3.4%)
Bachelor's Degree or Higher	76.9%	46.6%
Median Household Income	\$50k–\$69,999 (19%) \$70k–\$99,999 (13.6%)	\$50k–\$100k (30%) \$79,547 (med)

Note: Survey respondents selected from Likert scale demographic categories that do not align exactly with the New Hanover County reporting categories from the 2024 American Community Survey 1-year estimate. Therefore, direct comparisons should be interpreted with caution.

To assess the survey response rate, the survey addresses and responses were compared by aggregating these data to the zip codes entered on the survey responses (Figure 2). There was a high

correlation (0.969807) between the number of surveys mailed to each zip code and the response rate, and the response rate was higher in areas with higher vulnerability (Figure 1). Therefore, we concluded that even though there was a low survey response rate (estimated at 2–3%), the responses reflect the survey design.

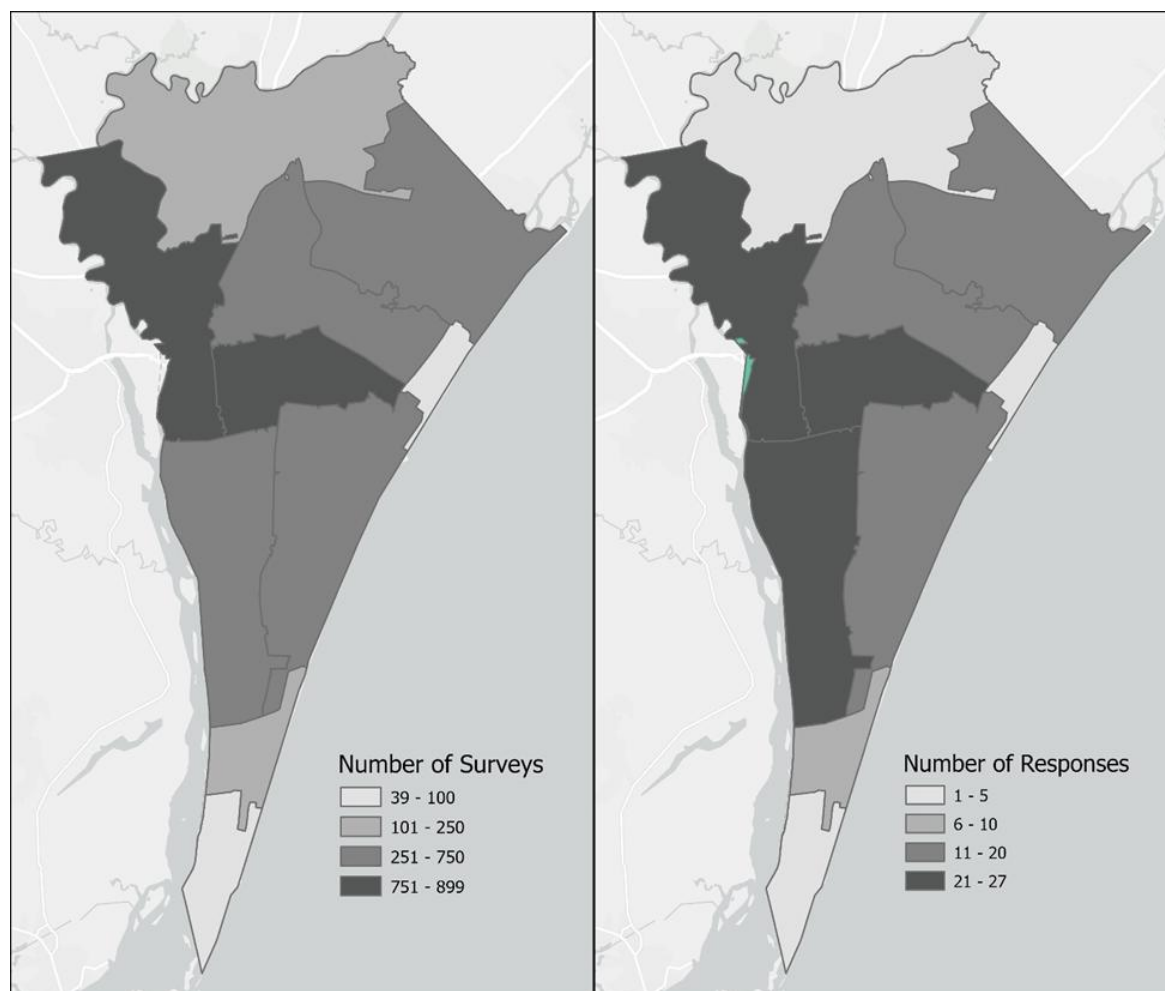


Figure 2. Number of survey responses. On the left is the number of surveys mailed to each zip code and on the right is the number of responses per zip code.

To address RQ 1 regarding residents' perceptions of changes in their neighborhood and the impact of natural hazards such as Hurricane Florence on the gentrification process, respondents were asked to express their level of agreement that indicates their neighborhood change since 2018 Hurricane Florence or their dates of residency using a 5-point Likert Scale (1 = strongly disagree and 5 = strongly agree) (Table 3). We found that nearly 92.7% of respondents agreed or strongly agreed that their neighborhood's cost of living was increasing. Over 55% of the respondents agreed or strongly agreed that younger groups (ages 20–40) have moved into their neighborhood, and almost 48% of the respondents agreed or strongly agreed that more White (non-Hispanic) people have moved into their neighborhood. Most agreed and strongly agreed that there are new houses (62.8%) or new apartments (56.6%) in or near their neighborhood, and there are more houses under renovation (52.5%).

Responses ranged in agreement with questions relating to beautification efforts in the neighborhood development. The most common answers indicated that respondents disagree or strongly disagree with the presence of visible beautification efforts, such as the addition of parks and green spaces, in their neighborhood (48.2%). Last, 50.3% of respondents noticed new amenities, such as restaurants or shops near their homes.

Table 3. Residents' Perceptions of Neighborhood Change (N = 155).

Survey Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The cost of living is increasing in the neighborhood.	2.9%	1.5%	2.9%	43.8%	48.9%
There are younger age groups (ages 20-40) moving into the neighborhood.	7.3%	16.1%	21.2%	46.7%	8.8%
There are new houses in or near the neighborhood.	8.8%	23.4%	5.1%	38.0%	24.8%
There are new apartments in or near the neighborhood.	8.8%	23.5%	11.0%	31.6%	25.00%
There are more White (non-Hispanic) people moving into the neighborhood.	2.2%	20.6%	29.4%	33.8%	14.0%
There are visible beautification efforts in the neighborhood, such as the addition of parks and green spaces.	12.4%	35.8%	25.5%	18.2%	8.0%
There are more houses under renovation in the neighborhood.	5.8%	19.0%	22.6%	40.1%	12.4%
There are new amenities in or near the neighborhood, such as restaurants, coffee shops, grocery stores, etc.	6.6%	22.6%	20.4%	37.2%	13.1%

Table 4. Residents' Perceptions of the Impacts of Natural Hazards on the Gentrification Process (N = 155).

Survey Question	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Flooding from Hurricane Florence in 2018 has influenced gentrification in your neighborhood.	17.1%	33.3%	31.0%	11.6%	7.0%

To assess residents' perceptions of the impacts of natural hazards on the gentrification process in their neighborhood, respondents were asked whether flooding from Hurricane Florence influenced gentrification in their neighborhood. The majority disagreed with the statement (33.3%), while 17.1% strongly disagreed. Only 18.6% agreed or strongly agreed that flooding from Florence influenced gentrification in their neighborhood. Approximately one-third of the respondents (31%) stayed neutral about the impacts of Florence on gentrification in their neighborhood, as shown in Table 4. Factors influencing these attitudes were investigated to better understand the reasons that might cause these opinions.

3.2. Multivariate regression

To answer RQ 2, we performed a multivariate regression analysis to identify factors that may impact residents' perceptions of the impacts of Hurricane Florence on the gentrification process. We hypothesized that gentrification would be significantly related to residents' familiarity with the concept of gentrification, their observation of neighborhood change, disaster recovery policies, residential status, and sociodemographic characteristics. We also hypothesized that residents' length of residence, whether their property sustained damage during Hurricane Florence, and their perceptions of gentrification status would significantly contribute to the impacts of natural hazards on gentrification.

3.2.1. Dependent variable

To measure the impacts of natural hazards on gentrification, we asked residents to indicate their level of agreement with "flooding from Hurricane Florence in 2018 has influenced gentrification in their neighborhood" using a 5-point Likert Scale ranging from strongly disagree (1) to strongly agree (5).

3.2.2. Independent variables

Residents' familiarity with the concept of gentrification was measured by a 5-point Likert Scale ranging from not familiar (1) to very familiar (5). Approximately two-thirds of the respondents (68.8%) indicated they were either very familiar or extremely familiar with the concept.

Table 5. Unweighted Vs. Weighted Descriptive Statistics for Demographic Variables.

	Unweighted	Weighted
Race (% White)	86.4%	71.4%
Gender (% Female)	61.7%	52.0%
Education (% Bachelor's degree or higher)	76.9%	76.3%
Residential Status (% Owners)	69.4%	71.7%
Property Damage (% Yes)	69.7%	67.1%
Median Household Income		
\$0 to \$14,999	2.0%	2.7%
\$15,000 to \$29,999	4.8%	4.9%
\$30,000 to \$39,999	4.1%	3.0%
\$40,000 to \$49,999	8.8%	10.0%
\$50,000 to \$69,999	19.0%	15.3%
\$70,000 to \$99,999	13.6%	13.0%
\$100,000 to \$149,999	15.6%	14.5%
\$150,000 to \$199,999	8.8%	8.8%
\$200,000+	11.6%	13.5%
Would rather not say	11.6%	14.3%

To assess perceptions of post-disaster recovery policies, respondents were asked to indicate their level of agreement with the statement: “Disaster recovery policies, such as rebuilding efforts, have influenced gentrification in your neighborhood.” This variable captured respondents’ perceptions of whether recovery-related policies, such as rebuilding initiatives following Hurricane Florence, contributed to neighborhood change and was included as an independent predictor variable. Over one-third (36.4%) of the respondents neither agreed nor disagreed with the statement, 41.8% disagreed or strongly disagreed, and 21.7% agreed or strongly agreed. Residents’ observation of neighborhood change was measured by asking them to express their feelings about it on a 5-point Likert Scale of worse to better in the last five years. On average, respondents perceived their neighborhood as having remained stable or improved over the past five years, with 59.1% reporting that conditions had stayed the same or become slightly better. In contrast, 22.6% believed their neighborhood had worsened or slightly worsened, while 18.2% felt it had improved. The survey collected information on residents’ perceptions of gentrification status by asking whether they agreed that gentrification was increasing in their neighborhood. A quarter of the respondents (25%) answered that they neither agreed nor disagreed, while 46.9% agreed or strongly agreed with the statement. A little over a quarter of the respondents (28.2%) either strongly disagreed or disagreed that gentrification was increasing in their neighborhood. Other independent variables include residential status (renters vs. owners), whether the property has experienced damage, and respondents’ sociodemographic characteristics such as race, gender, household income, education, and length of residency.

Post-stratification weights were applied to adjust for demographic disproportionalities in race, gender, and educational attainment. Race weights were constructed by comparing sample proportions to New Hanover County population benchmarks: White respondents represented 86.4% of the sample but 71.5% of the county population, whereas Non-White respondents comprised 13.6% of the sample and 28.5% of the population. Weights were computed as population-to-sample ratios, yielding 0.827 for White respondents and 2.095 for Non-White respondents. These weights were applied in all analyses to align the weighted sample with county-level racial composition.

Table 6. Unweighted Vs. Weighted Descriptive Statistics for Key Variables.

Variables	Unweighted			Weighted		
	Mean	Standard Deviation	Skewness	Mean	Standard Deviation	Skewness
Disaster recovery policies	2.72	1.104	0.221	2.65	1.043	0.252
Neighborhood change in the last 5 years	3.37	1.138	−0.257	3.46	1.103	−0.262
Conceptual knowledge of gentrification	3.9	1.064	−0.871	3.84	1.069	−0.974
Gentrification is increasing in your neighborhood	3.2	1.173	−0.345	3.15	1.12	−0.262
Impacts of Natural Hazards on Gentrification	2.58	1.116	0.443	2.5	0.999	0.457

Similarly, gender weights were derived using New Hanover County population targets, indicating that 48% of county residents are male and 52% are female, compared to 35.7% male and 61.7% female

in the sample responses. Post-stratification ratios produced weights of 1.345 for male respondents and 0.842 for female respondents, correcting for under- and over-representation, respectively. Table 5 and Table 6 show unweighted and weighted descriptive statistics for demographics and key variables. Multivariate Regression analysis was reperformed using weighted cases based on the weighted race and gender variable (weighted race by weighted gender).

Table 7. Multivariate Regression Analysis Results for Factors Influencing Residents' Perceptions of Impacts of Hurricane Florence on Gentrification.

Independent Variable	Unstandardized		Standardized Coefficients Beta	P value	95% Confidence		VIF
	Coefficients				Interval for B		
	B	Std. Error			Lower Bound	Upper Bound	
Constant	1.051	0.468		0.033	0.093	2.010	
Disaster recovery policies (P)	0.572	0.097	0.665	0.000** ¹	0.373	0.772	2.587
Neighborhood change in the last 5 years (C)	0.237	0.076	0.280	0.004**	0.082	0.392	1.615
Conceptual knowledge of gentrification (K)	−0.167	0.104	−0.181	0.121	−0.380	0.047	2.599
Household income (I)	−0.119	0.044	−0.274	0.011*	−0.208	−0.030	2.037
Education (E)	0.217	0.098	0.232	0.0355	0.017	0.418	2.208
Residential status (Rent vs. Own) (R)	−0.846	0.289	−0.282	0.007**	−1.438	−0.255	1.871
Gender	−0.036	0.175	−0.019	0.838	−0.395	0.323	1.750
Gentrification is increasing in your neighborhood	0.056	0.096	0.071	0.562	−0.140	0.253	2.916
Length of residency	−0.005	0.009	−0.041	0.615	−0.023	0.014	1.299
Property damage	−0.077	0.163	−0.040	0.642	−0.411	0.258	1.435
Adjusted R Square: 0.810; F = 17.331							
*Significant at 0.05 level; ** significant at 0.01 level							
¹ 2.43045599444231E-06							

After applying the post-stratification weight, SPSS automatically excluded the race variable from the weighted regression model. This occurred because the weighting procedure substantially reduced the effective sample size for certain race categories. When this happened, SPSS could not compute the necessary variance–covariance matrix, and the software identified the variable as having “no variation” or “missing correlations”. As a result, race was treated as constant and was dropped from the model. Although race is an important demographic variable in this study, the weighted data structure did not retain enough usable variation for SPSS to estimate a stable coefficient. This exclusion reflects a technical limitation of the weighted dataset rather than a theoretical decision to omit the race variable. Multivariate regression analysis revealed that the predictors/independent variables explained 81%

(Adjusted R Square = 0.81) of the dependent variable's variance, and the regression model is statistically significant ($F = 17.331$) (Table 7):

$$G = 1.051 + 0.572(P) + 0.237(C) - 0.119(I) + 0.217(E) - 0.846(R) - 0.036(G).$$

where G is the gentrification, P is policies, C is neighborhood change, I is income, E is education, and R is renter-occupied housing.

The values of VIF for the independent variables in our model ranged from 1.299 to 2.916, which are less than ten, indicating no multicollinearity problem. Examination of other assumptions for the multivariate regression analysis showed: (1) The dependent and independent variables were linear; (2) the data were normally distributed; and (3) homoscedasticity.

Two of the sociodemographic characteristics of the respondents, education and annual household income, showed a significant relationship with the dependent variable. For example, education level ($p = 0.0355$) was positively associated with perceptions of the impacts of natural hazards on gentrification, as shown in Table 7. That is to say, respondents with a higher level of education are more likely to agree with the statement that “flooding from Hurricane Florence in 2018 has influenced gentrification”. Individuals with higher educational attainment may have a greater understanding of gentrification processes and the impacts of recovery investments or greater access to news or academic literature describing these topics. Perhaps, as Zuk et al. [35] found, individuals with higher levels of education are often newcomers in gentrifying neighborhoods. It is possible that their firsthand experiences of post-Hurricane neighborhood change contributed to their awareness of gentrification processes.

Annual household income had a significant negative relationship with residents' perceptions of the impacts of natural hazards on gentrification ($P = 0.011$). Respondents with a higher household income level were less likely to agree that flooding from Hurricane Florence in 2018 has influenced gentrification in their neighborhoods. One possible explanation is that higher-income residents live in areas that are not gentrified and areas of the city that are less severely affected by natural hazards. Low-income households are frequently forced to live in areas subjected to higher flooding, whether for economic reasons or discrimination [55]. Additionally, lower-income and middle-income households are most likely to experience gentrification firsthand [27] and, therefore, see the repercussions before wealthier communities.

Gender was not significantly related to residents' perceptions of natural hazard impact on gentrification ($P = 0.838$); however, the variable was negative (-0.036). Male respondents were less likely to agree that flooding from Hurricane Florence in 2018 has influenced gentrification in their neighborhoods. One possible interpretation is that male respondents may perceive gentrification processes as less directly impacting them and prior research concluded that women have historically been more vulnerable to gentrification risks [32,33].

Residential status (renters vs. owners) had a significantly negative relationship with the perceived impacts of natural hazards on gentrification ($P = 0.007$). Owners were less likely than renters to agree that flooding from Hurricane Florence in 2018 has influenced gentrification in their neighborhoods. Hwang & Sampson [26] suggested that renters, particularly, are more likely to experience constrained moves. Therefore, renters may perceive themselves as more vulnerable to increased rent or landlord evictions following a disaster. However, this contradicts the results of Antunes et al. [30], who stated that owners are more likely to perceive gentrification processes than renters. The length of residency

and experience with property damage during Hurricane Florence are not significantly related to the perceived impacts of natural hazards on gentrification.

Next, we examined the independent variables related to residents' perceptions. Residents perceived neighborhood change ($P = 0.004$) as positively related to the perceived impacts of natural hazards on gentrification. This relationship was statistically significant. Respondents who indicated that their neighborhood had improved in the last five years were more likely to have a higher level of agreement that flooding from Hurricane Florence has influenced gentrification in their neighborhood. To our knowledge, there is no literature on the relationship between perceived neighborhood change and the impact of natural hazards on gentrification. Therefore, we analyzed the qualitative data from the survey's final question, which invited respondents to share comments on Hurricane Florence and neighborhood change, to gain further insights.

Many of the responses mentioned new developments in their neighborhood. There were perceived positive associations with the new neighborhood development, like new small businesses, which increased the quality of living. However, there were also a few negative associations with increasing development, such as increasing housing and rent prices and damage to surrounding natural areas, such as marshes, woody areas, and drainage ways, that would help mitigate flooding. Concerns were also expressed toward community planning. Some respondents thought much of the development was being approved without plans to help reroute flooding or implement flood control. Aside from new development, it was also commonly mentioned that there was a lot of home buying and house flipping in respondents' neighborhoods. Respondents mentioned that their neighbors believed it was easier to sell property than pay for repairs post-Florence, and a few responses mentioned the presence of "cash for keys" developers who came in to buy homes, repair them, and sell them for a much higher price.

The coefficient for the disaster recovery policy perception variable, measured by respondents' agreement with the statement that rebuilding efforts and related recovery policies influenced gentrification in their neighborhood, was positive and statistically significant ($P < 0.001$). This suggests that respondents who believe disaster recovery policies have influenced gentrification in their neighborhood are more likely to agree that flooding from Hurricane Florence has influenced gentrification in their neighborhood. One possible interpretation is that respondents who perceive disaster recovery policies, such as rebuilding infrastructure, recognize that these programs can attract investments, which may increase property values and shift socioeconomic compositions. Adams et al. [21] found similar results in New Orleans after Hurricane Katrina, as these residents expressed that rebuilding efforts would lead to gentrified areas. Thus, in the aftermath of Hurricane Florence in NHC, recovery initiatives may have facilitated new development and infrastructure improvements that made neighborhoods more desirable to higher-income residents, which may have accelerated gentrification. Comments from the open-ended responses included increased development, concerns about flood mitigation in community planning, lack of government assistance post-Florence, challenges with insurance claims, decreases in affordable housing, and recovery processes that took longer than expected. The frequent mentioning of development and house flipping in respondents' areas align with ideas presented by Aune et al. [14], Gotham [23], and Matsushita et al [15], who stated in their research that government decisions aim to boost economic growth during recovery phases through increased development and that in cases such as Hurricane Katrina, many residents opted for selling and moving rather than bearing expenses associated with recovery.

Familiarity with gentrification is not significantly associated with perceptions of the impacts of natural hazards on gentrification. Respondents' perspectives on the factors influencing gentrification varied among the open-ended answers. Some respondents believed that Florence has taken no part in neighborhood change and that gentrification is just a side effect of inflation or the economics of coastal real estate. The impacts of COVID-19 and the pandemic shutdown were also frequently mentioned to have taken a large toll on gentrification, and a few respondents believed the extended recovery from Florence made the impacts of the shutdown worse than they would have been in many areas.

4. Discussion and conclusions

We to examine the impact of a natural hazard on the gentrification process in NHC. This research was novel in that the relationship between natural hazards and gentrification was assessed through perceived visible cues and residents' perceptions, while the prevalent studies on gentrification and natural hazards have based their research on census data by measuring a census tract's susceptibility to gentrification. We surveyed to understand residents' perceptions of how Hurricane Florence and its aftermath may have impacted their neighborhood change and gentrification process in New Hanover County. Our results showed a collective response of an experienced increase in younger/middle-aged populations moving into the area, an increase in more White non-Hispanic individuals, increases in housing or other apartments being constructed, increases in living costs, and increases in amenities around the neighborhood. The only inconsistent perception from the survey participants observed increase in visible beautification efforts in respondents' neighborhoods.

Approximately one-third of the respondents (31%) stayed neutral about the impacts of Florence on gentrification in their neighborhood. About half of the respondents did not believe Hurricane Florence and its aftermath affected the gentrification process in their neighborhoods. To better understand this diversified opinion, multivariate regression analysis was performed to identify factors that may impact residents' perceptions of the impacts of Hurricane Florence on the gentrification process. Results from multivariate regression analysis showed that respondents' education level, annual household income, residential status (renters vs. owners), their perceived neighborhood change in the past five years and residential status in the neighborhood, and disaster recovery policies were statistically significant factors influencing residents' perceptions of the impacts of Hurricane Florence on the gentrification process.

While most researchers have focused on New Orleans, Louisiana, after facing Hurricane Katrina in 2005, this study in NHC can serve as a foundation for future research analyzing natural hazards' impacts on neighborhood change processes. It was also interesting to note that many open-ended responses perceived Hurricane Florence as just one variable contributing to gentrification in NHC. Based on open-ended responses, residents are interested in seeing research on the disparities in flood insurance between income levels and how gentrification has been influenced by factors such as inflation, COVID-19, and coastal real estate, in addition to Hurricane Florence's impacts. In future research, we will include these suggested variables in our model. We also recognize that neighborhood changes and the gentrification processes could differ based on respondents' individual neighborhoods.

Researchers should continue to explore the perceptions of gentrification that may occur from natural hazards, since gentrification and neighborhood changes are processes. Our survey was

conducted less than five years after Hurricane Florence made landfall, and communities may continue to see the full effects of gentrification processes in their neighborhoods. Other future research could incorporate geospatial data and techniques to capture the neighborhood-specific characteristics. Additionally, in-depth interviews with residents could provide additional insights into understanding how recovery initiatives, such as new development and infrastructure improvements, may influence gentrification processes.

Overall, our findings underscore the importance of ensuring that disaster recovery policies prevent displacement and promote long-term socioeconomic stability. Neighborhood change processes like gentrification can impact a resident's ability to maintain quality of life post-natural hazard. Gentrification can shape residents' subjective meanings, perceptions, experiences, and expectations associated with their homes and communities, which is important for urban decision-makers to consider post-hazard redevelopment. Urban decision-makers and planners can utilize the insights from this research to enhance recovery strategies by prioritizing physically and socially vulnerable communities and mitigating the risks of disaster capitalism. These findings can help guide recovery initiatives not only in coastal North Carolina counties but also in other communities vulnerable to future natural hazards.

5. Limitations and future research

It is important to note that this study has several limitations that should be considered when interpreting the findings. First, because all variables were collected within a single survey instrument, the potential for common-method variance and consistency bias cannot be eliminated. Although this concern is inherent in cross-sectional survey designs, we attempted to mitigate it through the intentional sequencing of questionnaire items. All demographic measures and key independent variables, except for the post-disaster discovery policy variable, were positioned earlier in the survey, prior to the outcome variable, thereby establishing a basic temporal ordering consistent with the theorized direction of effects. Only the post-disaster recovery policy measure appeared adjacent to the outcome variable. Additionally, the directional relationships examined in this study were grounded in established theoretical and empirical literature, which provides further justification for the assumed ordering despite the shared measurement context. Although we attempted to reduce common-method variance through item sequencing and theoretically grounded directional hypotheses, a formal statistical test for common-method bias was not possible with the available data. Such tests require either a theoretically unrelated marker variable or multi-indicator constructs that enable estimation of a latent method factor. Our survey did not include an unrelated marker item (e.g., a question about preferences for environmentally friendly office supplies). In addition all key constructs were measured with single-item indicators rather than multi-item scales (e.g., a set of items assessing the existence, comprehensiveness, implementation, and periodic updating of disaster recovery policies, or multiple items evaluating respondents' conceptual understanding of gentrification). Consequently, statistical assessment of common-method bias was not feasible, and the possibility of method effects should be considered when interpreting the findings. In future work, researchers should take this common method bias into account.

Second, the study's relatively low response rate and limited information about non-respondents restrict our ability to formally assess non-response bias. Limited information about non-respondents prevents us from conducting a formal non-response bias check. To help reduce the potential impact of these discrepancies, we constructed post-stratification weights using demographic distributions from the New Hanover County population for race and gender and applied the weights to all cases when performing the multivariate regression analysis. While weighting cannot fully substitute for direct non-response diagnostics, it improves representativeness and provides a reasonable corrective approach given the available data. Future research would benefit from strategies that enable more robust assessment of non-response patterns.

Third, the regression analysis indicates that education level is positively associated with perceptions that natural hazards contribute to gentrification. Respondents with higher levels of education were more likely to agree that "flooding from Hurricane Florence in 2018 has influenced gentrification." This suggests that more highly educated individuals may be more attuned to or more likely to interpret environmental events through the lens of a broader socioeconomic framework. However, this finding requires careful interpretation. The survey sample is disproportionately composed of highly educated respondents, with 76.9% holding a bachelor's degree or higher. This imbalance limits the representativeness of the findings and may influence the observed associations between education and perceptions of gentrification. The lower percentage of respondents with lower education levels reduces the model's ability to capture the full range of perspectives in the population. Consequently, the observed positive association between education and perceptions of hazard-related gentrification may be partially shaped by the sample composition rather than reflecting a uniformly strong relationship across all educational groups.

Fourth, natural hazards, flooding pathways, and processes of gentrification are inherently spatial phenomena. Individuals living in the same or adjacent neighborhoods are likely to share correlated hazard exposures, built-environment characteristics, and neighborhood perceptions. However, the survey did not yield sufficient spatial detail to allow us to geocode responses to evaluate spatial autocorrelation. As a result, we were unable to test spatial clustering or estimate spatial regression models that could account for neighborhood-level spatial dependence. Researchers should incorporate more precise geographic identifiers, while maintaining confidentiality, to enable spatially explicit analyses that better capture the geographic structure of hazard exposure and neighborhood change.

Fifth, data were collected approximately five years after Hurricane Florence, which introduces the potential for recall bias. Because participants were asked to reconstruct their experiences long after the event, their accounts likely reflect retrospective interpretations rather than precise recollections; as a result, these retrospective reports should be understood as subjective narratives shaped by time, emotion, and subsequent experiences, rather than as evidence capable of establishing direct causal effects.

Sixth, missing rates for key independent variables ranged from 0% to 19%. Because we applied a listwise case-exclusion approach for the regression analyses, any case with missing data for one or more variables was removed, reducing the effective sample size and likely lowering statistical power. This loss of data may have limited our ability to detect true effects. Multiple imputation would have been preferable for preserving power and reducing bias, but we were unable to implement it due to limitations of the available SPSS package.

In summary, the study limitations highlight several promising directions for future research. Longitudinal or multi-wave survey designs would help strengthen causal inference and reduce concerns about common-method bias. Improved sampling strategies and the collection of limited, privacy-preserving spatial identifiers would enable researchers to assess non-response patterns and to model spatial dependence more rigorously. Integrating these methodological enhancements would deepen our understanding of how residents perceive and respond to environmental risks and neighborhood transformations.

Author contributions

Huili Hao: Conceptualization, Funding acquisition, Investigation, Methodology, Data Curation, Formal analysis, Writing-original draft, and Supervision. Meredith Hovis: Conceptualization, Writing – original draft, review and editing. Joanne Halls: Methodology, Writing-review and editing, Visualization, Validation and Supervision. Helen Arnold: Funding Acquisition, Investigation, Project Methodology, Administration, Writing -review and editing, and Visualization.

Use of Generative-AI tools declaration

The author(s) declare(s) they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Hughes W, Zhang W, Ding Z, et al. (2022) Integrated Structural and Socioeconomic Hurricane Resilience Assessment of Residential Buildings in Coastal Communities. *Nat Hazards Rev* 23. [https://doi.org/10.1061/\(asce\)nh.1527-6996.0000564](https://doi.org/10.1061/(asce)nh.1527-6996.0000564)
2. NOAA, Hurricane Florence: September 14, 2018. National Weather Service, 2019. Available from: <https://www.weather.gov/ilm/HurricaneFlorence>.

3. Federal Emergency Management Agency (FEMA), Community Emergency Response Team (CERT) Program, 2020. Available from: <https://www.ready.gov/community-emergency-response-team>.
4. Maione C (2019) Recovery Planning After Hurricane Katrina: A Case of Climate Justice. *Agora J Urban Plann Design*, 102–113.
5. Cano Pecharroman L, Hahn C (2024) Exposing disparities in flood adaptation for equitable future interventions in the USA. *Nat Commun* 15: 8333. <https://doi.org/10.1038/s41467-024-52111-0>
6. Banaji M, Fiske S, Massey D (2021) Systemic racism: individuals and interactions, institutions and society. *Cogn Research* 6: 82. <https://doi.org/10.1186/s41235-021-00349-3>
7. Wyczalkowski CK, Van Holm EJ, Esnard, A, et al. (2019) Uneven neighborhood recovery: Hurricane damage and neighborhood change in the Houston–Galveston region. *City Community* 18: 689–709. <https://doi.org/10.1111/cico.12390>
8. De Koning K, Filatova T (2020) Repetitive floods intensify outmigration and climate gentrification in coastal cities. *Environ Res Lett* 15: 034008. <https://doi.org/10.1088/1748-9326/ab6668>
9. Keenan JM, Hill T, Gumber A (2018) Climate gentrification: from theory to empiricism in Miami-Dade County, Florida. *Environ Res Lett* 13: 054001. <https://doi.org/10.1088/1748-9326/aabb32>
10. Bullard RD, Wright B (2009) *Race, Place, and Environmental Justice after Hurricane Katrina: Struggles to Reclaim, Rebuild and revitalize New Orleans and the Gulf Coast*, Philadelphia (PA): Westview Press.
11. Hallegatte S, Bangalore M, Vogt-Schilb A (2016) *Socioeconomic Resilience: Multi-Hazard Estimates in 117 Countries*. Policy Research Working Paper No. 7886. Washington (DC): The World Bank. Available from: <https://hdl.handle.net/10986/25688>.
12. Walker G, Burningham K (2011) Flood risk, vulnerability and environmental justice: evidence and evaluation of inequality in a UK context. *Crit Soc Policy* 31: 216–240. <https://doi.org/10.1177/0261018310396149>
13. Van Holm EJ, Wyczalkowski CK (2019) Gentrification in the wake of a hurricane: New Orleans after Katrina. *Urban Stud* 56: 2763–2778. <https://doi.org/10.1177/0042098018800445>
14. Aune KT, Gesch D, Smith GS (2020) A spatial analysis of climate gentrification in Orleans Parish, Louisiana post-Hurricane Katrina. *Environ Res* 185: 109384. <https://doi.org/10.1016/j.envres.2020.109384>
15. Matsushita T, Ghezelloo Y, Maly E, et al. (2024) Placemaking mediating dilemmas by addressing the gaps in post-disaster recovery process: Long-term citizen-driven place-nurturing in New Orleans after hurricane Katrina. *Int J Disaster Risk Reduct* 106: 104457. <https://doi.org/10.1016/j.ijdrr.2024.104457>
16. Lee D (2017) Neighborhood Change Induced by Natural Hazards. *J Plan Lit* 32: 240–252.
17. Sawicki DS, Flynn P (1996) Neighborhood indicators: A review of the literature and an assessment of conceptual and methodological issues. *J Am Plan Assoc* 62: 165–183. <https://doi.org/10.1080/01944369608975683>
18. Pricope NG, Halls JN, Rosul LM (2019) Modeling residential coastal flood vulnerability using finished-floor elevations and socio-economic characteristics. *J Environ Manage* 237: 387–398. <https://doi.org/10.1016/j.jenvman.2019.02.078>

19. Marson SM, Legerton M (2021) Disaster diaspora and the consequences of economic displacement and climate disruption, including Hurricanes Matthew (October 8, 2016) and Florence (September 14, 2018) in Robeson County, North Carolina. *Nat Hazards* 107: 2247–2262. <https://doi.org/10.1007/s11069-021-04529-8>
20. Lees L, Slater T, Wyly E (2013) *Gentrification*, London: Routledge.
21. Adams V, Van Hattum T, English D (2009) Chronic disaster syndrome: Displacement, disaster capitalism, and the eviction of the poor from New Orleans. *Am Ethnol* 36: 615–636. <https://doi.org/10.1111/j.1548-1425.2009.01199.x>
22. Gould KA, Lewis TL (2018) Green gentrification and disaster capitalism in Barbuda. *NACLA Rep Am* 50: 148–153. <https://doi.org/10.1080/10714839.2018.1479466>
23. Gotham KF (2007) (Re)Branding the Big Easy: Tourism Rebuilding in Post-Katrina New Orleans. *Urban Aff Rev* 42: 823–850. <https://doi.org/10.1177/1078087407300222>
24. Wright K, Kelman I, Dodds R (2021) Tourism development from disaster capitalism. *Ann Tour Res* 89: 103070. <https://doi.org/10.1016/j.annals.2020.103070>
25. Cohen E (2011) Tourism and land grab in the aftermath of the Indian Ocean tsunami. *Scand J Hosp Tour* 11: 224–236. <https://doi.org/10.1080/15022250.2011.593359>
26. Hwang J, Sampson RJ (2014) Divergent pathways of gentrification. *Am Sociol Rev* 79: 726–751. <https://doi.org/10.1177/0003122414535774>
27. Hammel DJ, Wyly EK (1996) A model for identifying gentrified areas with census data. *Urban Geogr* 17: 248–268. <https://doi.org/10.2747/0272-3638.17.3.248>
28. Owens ML, Schuett A, Crawford NN, et al. (2024) Race and perceptions of revitalisation in the ‘District of Gentrification’. *Urban Stud* 61: 1563–1580. <https://doi.org/10.1177/00420980231211819>
29. Pattillo M (2008) *Black on the Block: The Politics of Race and Class in the City*, Chicago: University of Chicago Press.
30. Antunes B, March H, Connolly JJ (2020) Spatializing gentrification in situ: A critical cartography of resident perceptions of neighborhood change in Vallcarca, Barcelona. *Cities* 97: 102521. <https://doi.org/10.1016/j.cities.2019.102521>
31. Freeman L, Braconi F (2004) Gentrification and displacement in New York City in the 1990s. *J Am Plan Assoc* 70: 39–52. <https://doi.org/10.1080/01944360408976337>
32. Curran W (2017) *Gender and Gentrification*, 1st Ed., Routledge. <https://doi.org/10.4324/9781315638157>
33. Enarson E (2006) Women and Girls Last? Averting the Second Post-Katrina Disaster. Denver Post (Op-Ed). Available from: <https://items.ssrc.org/understanding-katrina/women-and-girls-last-averting-the-second-post-katrina-disaster/>.
34. Kim H, Woosnam K, Kim H (2022) Urban gentrification, social vulnerability, and environmental (in) justice: Perspectives from gentrifying metropolitan cities in Korea. *Cities* 112: 103512. <https://doi.org/10.1016/j.cities.2021.103514>
35. Zuk M, Bierbaum AH, Chapple K, et al. (2018) Gentrification, displacement, and the role of public investment. *J Plan Lit* 33: 31–44. <https://doi.org/10.1177/0885412217716439>
36. McKinnish T, Walsh R, Kirk WT (2010) Who gentrifies low-income neighborhoods? *J Urban Econ* 67: 180–193. <https://doi.org/10.1016/j.jue.2009.08.003>

37. Adams G, O'Brien LT, Nelson JC (2006) Perceptions of racism in Hurricane Katrina: A liberation psychology analysis. *Anal Soc Issues Public Policy* 6: 215–235. <https://doi.org/10.1111/j.1530-2415.2006.00112.x>
38. Heanoy EZ, Brown NR (2024) Impact of Natural Disasters on Mental Health: Evidence and Implications. *Healthcare* 12: 1812. <https://doi.org/10.3390/healthcare12181812>
39. Amin RW, Rivera-Muñiz B, Guttmann RP (2021) A spatial study of quality of life in the USA. *SN Soc Sci* 1: 110. <https://doi.org/10.1007/s43545-021-00111-y>
40. Béné C, Frankenberger T, Griffin T, et al. (2019) “Perception matters”: New insights into the subjective dimension of resilience in the context of humanitarian and food security crises. *Prog Dev Stud* 19: 186–210. <https://doi.org/10.1177/1464993419850304>
41. Raker EJ, Woods T, Ramírez S, et al. (2023). Disasters and subjective assessments of recovery in the long run. *Popul Environ* 45: 1. <https://doi.org/10.1007/s11111-023-00415-6>
42. Shaw KS, Hagemans IW (2015) Gentrification Without Displacement and the Consequent Loss of Place: The Effects of Class Transition on Low-income Residents of Secure Housing in Gentrifying Areas. *Int J Urban Reg Res* 39: 323–341. <https://doi.org/10.1111/1468-2427.12164>
43. Brake E (2019). Rebuilding after disaster: Inequality and the political importance of place. *Soc Theory Pract* 45: 179–204. <https://doi.org/10.5840/soctheorpract201942956>
44. Chiodelli F, Caramaschi S, Grazioli M (2023) Toward a fine-grained understanding of informality: subjective meanings, perceptions, and expectations in informal housing trajectories. *Eur Urban Reg Stud* 32: 166–181. <https://doi.org/10.1177/09697764231203537>
45. Prayag G, Ozanne LK, Spector S (2021) A psychological wellbeing perspective of long-term disaster recovery following the Canterbury earthquakes. *Int J Disaster Risk Reduct* 63: 102438. <https://doi.org/10.1016/j.ijdrr.2021.102438>
46. WWAY News, 2020 visitor impact for New Hanover County. WWAYTV3, 2021. Available from: <https://www.wect.com/2021/10/08/visit-north-carolina-releases-2020-visitor-spending-impact-nhc/>.
47. US Census Bureau, American Community Survey 5-year estimates. Census Reporter Profile page for New Hanover County, NC. 2020. Available from: <http://censusreporter.org/profiles/05000US37129-new-hanover-county-nc/>
48. Justice40, Justice40 Tracts, 2022. Available from: <https://uncw.maps.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=341c98ee3ec44070ba922d8f56e1a5fa>.
49. Duncan C (2019) Hurricane Florence caused \$24 billion in damage, NOAA says. The News & Observer. Available from: <https://www.newsobserver.com/news/state/north-carolina/article225974185.html>.
50. Williams G (2019) NOAA: \$24 billion in damage from Florence, 9th most destructive in U.S. history. Available from: <https://www.wect.com/2019/05/04/florence-caused-billion-damage-th-most-destructive-hurricane-us-history/>.
51. Federal Emergency Management Agency (FEMA), Two Years After Hurricane Florence, \$2 Billion Provided for NC Recovery, 2020. Available from: <https://www.fema.gov/press-release/20250121/two-years-after-hurricane-florence-2-billion-provided-nc-recovery>.
52. Sullivan DM (2007) Reassessing gentrification. *Urban Aff Rev* 42: 583–592. <https://doi.org/10.1177/1078087406295828>

53. Field A (2018) *Discovering Statistics Using IBM SPSS Statistics*, 5th Ed., Thousand Oaks (CA): Sage Publications, Inc.
54. U.S. Census Bureau, American Community Survey 1-year estimates. Retrieved from Census Reporter Profile page for New Hanover County, NC. 2024. Available from: https://data.census.gov/profile/New_Hanover_County,_North_Carolina?g=050XX00US37129.
55. Galloway GE, Reilly A, Ryoo S, et al. (2018) The Growing Threat of Urban Flooding: A National Challenge. University of Maryland Center for Disaster Resilience & Texas A&M University Center for Texas Beaches and Shores. Available from: <https://stories.tamu.edu/wp-content/uploads/sites/4/2018/11/Urban-flooding-report-online.pdf>.



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