RESIDENTIAL SATISFACTION WITH HOME LOCATION: EXAMINATION OF THE RELATIONSHIP BETWEEN LOCATION-EMBEDDED BENEFITS AND RISK PERCEPTION

DISSERTATION

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Xueqin He, B.S., M.S.

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Committee Members Approved:

_____

John P. Tiefenbacher, Chair

_____

Alberto Giordano

_____

Nate Currit

_____

Debarun Majumdar

Approved:

_____

J. Michael Willoughby
Dean of the Graduate College

DEDICATION

To my mother:

Wang, Linhuo (王灵活)

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ABSTRACT

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by

Xueqin He, B.S., M.S.

Texas State University-San Marcos

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SUPERVISING PROFESSOR: JOHN TIEFENBACHER

Residents' satisfaction with their home location is believed to be directly related to the length of time when one lives in the place, to one's familiarity with the surrounding environment, and to one's willingness to invest in improving the environment. This study examines floodplain residents' satisfaction of their home location at respects of both location-based benefits and location-embedded risks. More specifically, it attempts to discern floodplain residents' attitudes toward their home locations, to determine factors

that contribute to their residential satisfaction, to identify residents' behavioral adjustment to perceived dissatisfactions with their residential environments, to understand their preferences for location-related features, to gauge their awareness of location-related risks, and to assess the impact of awareness on residential environment choice.

The first-hand data were collected by a survey questionnaire partly through direct talks between surveyor and residents. The contents of the questionnaire cover residents' attitudes toward their home location, factors contributing to residents' satisfaction or dissatisfaction to their home location, and their awareness of flood risk and water-related natural amenities. The findings of this research can help to improve understanding of floodplain residents' attitudes toward their home locations, to develop more effective programs to manage the development in floodplains, and to provide needed information to improve floodplain residents' understanding of the hazardousness of their locations. In addition, it also contributes to behavioral studies in disaster by providing empirical linkages between behavior and choice.

CHAPTER 1

INTRODUCTION

Residential satisfaction measures the gap between households' actual and desired residential environment (Amerigo and Aragones 1997; Lee and Guest 1983; Galster and Hesser 1981). If perceived distance between the actual and the desired residential circumstances including interior and proximal exterior environments is small and acceptable, people are satisfied with their residential environment. Dissatisfaction with one's residential environment indicates incongruence between their perceived needs and their current condition. Residential satisfaction is recognized as an important predictor of an individual's quality of life and their response to residential location-related features (Sirgy and Cornwell 2002; Lu 1999; Speare 1974; Wolpert 1966). Residential satisfaction is one of the most often studied topics by sociologists, psychologists, planners, and geographers. The determinants of residential satisfaction include housing characteristics, neighborhood social, economic, and physical settings, and household socio-economic and demographic characteristics. However, few studies have evaluated the impact of location-related hazards on residential satisfaction and residential environment choice and preferences, even though significant amounts of property and human lives have been lost by dwelling in hazard-prone zones, such as on unstable

slopes, along coastal zones, in floodplains, or in earthquake-prone and hurricane-prone areas (Wisner 2000). Studies of hazards and disasters have found that property damage and loss of life could be dramatically reduced if development on and dwelling in hazard-prone areas was reduced (Burby and others 1999). The fact is that hazardous areas already have been developed and will continue to be developed. As a coastal nation, the U.S. has about 559 counties whose centers are located within 80km of an ocean or Great Lakes coast. These counties accounted for just 13 percent of the continental U.S. land area but 51 percent of the population and 57 percent of the civilian income in 2000 (Rappaport 2003). A study conducted by Burpee (1993) indicates that the population in coastal areas of the Atlantic and Gulf of Mexico has increased more than 2.5 times in the last four decades. A future event resembling the magnitude of the 1993 Upper Mississippi flood could cause much more damage because of the new development in the flood-impacted areas in the river basin (Hippe, Drazkowski, and Thorsell 2005). Given this situation, why do people continue to develop and live in higher risk areas? Are they satisfied or dissatisfied with their current residential location? What makes them satisfied or dissatisfied with their residential location?

Seven reasons are identified to explain residential occupation of flood-prone areas (Fordham 1992, 71; Kates 1962, 135). Studies find that the primary motivation for continuing to reside in hazardous areas is that the perceived benefits to residents outweigh their perceived costs (Chowdhury 2003; Chan 1995). The recognized location-embedded benefits include cheaper land prices, fertile soils, and proximity to towns or cities, work places, relatives, hospitals, schools, or other social services. In this study, these social benefits will be referred to as location-embedded social amenities. We know,

in addition to social amenities, location-embedded benefits also include natural amenities, including scenic views, clean air and quiet surroundings, outdoor recreational opportunities, and other activities based on the location-embedded biophysical environment. Natural amenities are usually emphasized by household-location choice studies (Li 2007), but are not found in hazard studies.

This dissertation examines whether or not residents are satisfied with their residential location and what factors influence their satisfaction. San Marcos River floodplain residents were chosen as the study population of this research because of extensive development in the floodplain and because of economic losses from floods (Grothmann and Reusswig 2006; Hippe, Drazkowski, and Thorsell 2005; Montz and Gruntfest 1986). Because residential satisfaction is an important predictor of households' responses to their residential location, studying floodplain residents' attitudes toward their residential environment is significant. Previous studies indicate that once the incongruence between residents' aspirations and achievements passes a certain threshold, it generates a level of dissatisfaction or stress for the household (Speare 1974; Wolpert 1966). Once the intensity of the dissatisfaction exceeds the threshold of tolerance, households may adopt some adjustments to relieve their dissatisfactions (Knox 1987, 186). The household may lower its perceived needs to meet their actual condition, or they may deny or become accustomed to their previously found dissatisfaction by employing cognitive adjustments (Shippee, Burroughs, and Wakefield 1980). The household may improve its housing or its environmental circumstances so that these more closely match the household's perceived needs and its aspirations through behavioral adjustments. Another form of behavioral adjustment adopted by some households is

residential relocation (Preston, Taylor, and Hodge 1983). These behavior adjustments are important for flood-prone developments and dwelling management. In the United States, environmental and housing improvement have been encouraged and widely adopted as effective responses to reduce the damages and losses caused by floods (Burby 2001; Tobin and Montz 1997). Moving out of flood-prone areas (such as floodplains) is claimed to be one of the most effective responses to reduce the damage caused by floods (Burby and others 1999). Therefore, an understanding of residents' attitudes towards their residential location is essential for improvement of hazard management.

Judgment about residential satisfaction is based on the needs and achievements of a household. That is, residential satisfaction is a dynamic process. Changes in either the needs or the achievements or both may change the degree of residential satisfaction. It may be hard to change residents' perceived residential needs but it is possible to change their actual residential environment to keep people away from hazardous areas. Revealing residents' degree of satisfaction with their home location and discovering the determinant of residential satisfaction among floodplain residents will help to understand floodplain residents' attitudes toward their home locations and residents' preferences of location-related benefits. This information will be useful to the development of more effective programs to manage floodplain development and to provide the necessary information to improve floodplain residents' understanding of the level of safety of their location. For example, if residents say that they are satisfied with their location-related social amenities, they may be more likely to move out of their current location if similar location-related social amenities are available at other locations that are less likely to flood. However, if people claim that they are satisfied with their location-related natural

amenities, they may be unlikely to move because the location-related natural amenities may be unique and irreplaceable (or "unsubstitutable" in their minds). On the other hand, if residents express that they are dissatisfied with their house location because of location-related social amenities, they may be more likely to move out of their current residence. More specifically, the management and policy implications of this dissertation are to determine the changeable location-related characteristics to influence residential satisfaction perceived by floodplain residents. The consequence of the shift would be that residents of floodplains would adopt adjustments to improve their residential satisfaction.

Furthermore, this dissertation studies households' attitudes toward their location. It can be regarded as a behavioral study because of the influences of attitudes on behavior. The fundamental premise is that residents' satisfaction with their home locations rationally determines their behaviors to maximize either their economic gains or their happiness. Therefore, this study also contributes to disaster-related theory by providing an empirical study to support behavioral assessments in disaster research.

CHAPTER 2

LITERATURE REVIEW

Residential satisfaction is a complex cognitive construct (Lu 1999). This chapter presents a review of the findings and limitations of previous studies of residential satisfaction. It contains discussions of three discrete topics: the determinants of residential satisfaction, choices and preferences for residential environments, and location-related risks and amenities in residential space. The findings of previous studies on floodplain living are reviewed too.

2.1 DETERMINANTS OF RESIDENTIAL SATISFACTION

In the literature, housing characteristics, neighborhood characteristics, and household characteristics have been viewed as the essential elements of the residential satisfaction (Lu 1999; Amerigo and Aragones 1997; Galster and Hesser 1981). Housing characteristics include the size and age of houses (Fang 2006; Levy-Leboyer and Ratiu 1993; Rodgers 1980), interior and proximal exterior environments (Phillips, Siu, and Yeh 2005), and other aspects of housing, e.g., building quality and disrepair (Paris and Kangari 2005). Housing satisfaction has been viewed as the most important predictor of residential satisfaction (Yi 1985).

Neighborhood social, economic, and physical features are major components of residential satisfaction (Sirgy and Cornwell 2002). The social features most often regarded as important include interaction with neighbors, attachment of the communities, perceptions of privacy and safety at home, and others (Bruin and Cook 1997; Feldman 1996; Weidemann and Anderson 1982). Neighborhood socio-economic status and home values, and community cost of living are factors used to measure the economic features of neighborhood (Lu 1999; Galster and Hesser 1981). Physical features are other infrastructural and equipment settings, and these regard the quality of environment of the community, such as lighting of streets (Dahmann 1983), crowding and noise level (Gomez-Jacinto and Hombrados-Mendieta 2002; Bonnes, Bonaiuto and Ercolani 1991), and green area or open space (Turner 2005; Bender and others 1997).

In addition, empirical studies have identified a number of important factors belonging to household characteristics, such as age, income, duration of residence, and ownership of house (Lu 1999; Spear 1974). But there is little agreement on the effect of these factors on residential satisfaction. Lu (1999) argues that the inconsistent or conflicting results of research may be due to different definitions of key variables as well as to inappropriate statistical techniques employed.

2.2 RESIDENTIAL ENVIRONMENT CHOICE & PREFERENCE

Empirical studies of residential choice suggest that the process of searching for a home consists of two scales of consideration: the evaluation and choice of residential areas, and then the search for vacancies within an acceptable area (Preston and Taylor 1981; Barrett 1976). Accessibility and pleasantness are identified as major location

attractions for the housing consumers (Kauko 2006 a and b; Raju, Sikdar, and Dhingra 1998). Pleasantness characterizes a pluralist locational preference based on various individual lifestyles that depend on values and beliefs (Lindberg and others 1988). These preferences include residential density, cost of housing, cost of living, ethnicity of neighbors, social facilities, the quality of the natural and social environments, and so on (Li 2007; Kim, Horner, and Marans 2005).

A review of the literature on residential preferences reveals the significance of the influence of life-course on residential location choice. Childless groups are overrepresented in the larger standard metropolitan statistical areas (SMSAs) that are of relatively higher density and provide easier access to services than do suburban and rural areas (Kim, Horner, and Marans 2005; Lee and Guest 1983; Rhoda 1977). Households with children have a strong preference for low-density dwellings with plenty of green space and recreational opportunities because such environments are believed to be better for rearing children (Fjortoft and Sageie 2000). Other household socio-economic and demographic characteristics also contribute to residential location preferences. For example, residential preferences are found to be heavily influenced by the availability of an automobile, but are much less affected by race and employment status (Chapman and Ritzdorf 1986).

Preference for location-related environmental amenities has also been studied. Warm winters and cooler, less-humid summers are attracting more and more residents. This is now regarded a consumption amenity (Rappaport 2007). Recent college graduates have been found to be less likely to move away from their home state if it was on a sea-coast or had low average wind speeds (Kodrzycki 2001). Housing markets have

incorporated the value of the natural environment into the price of a house and rent because it has been found that residents are willing to pay more for an apartment or house with desirable natural amenities (Hui and others 2007). For example, a scenic view is an important predictor of housing price (Benson, Hansen, and Schwartz 2000; Rodriguez and Sirmans 1994); permanent open space increases nearby residential land values more than three times the value of an equivalent amount of developable open space (Geoghegan 2002). Residents' preferences for water amenities are reflected by the values of residential real estate. A house's price will be increased 8-10 percent if it overlooks water (Luttik 2000). The mean house value increases $258.81 for each 1000 feet that a house is nearer to a stream (Mahan, Polasky, and Adams 2000).

Talbot and his co-workers (1987) point out that contact with nature offers compelling and wide- ranging benefits to individuals (through actively participating in outdoor recreation or observing nature). For example, spending time outdoors has been found to have therapeutic potential for older adults (Rodiek 2005). Therefore, it is not a surprising that the perceived availability of, and interaction with natural environments are vital sources of satisfaction with neighborhoods and with life in general (Frey 1981). People with strong preferences for certain natural amenities are willing to sacrifice other residential attributes (e.g., a large lot) (Colwell, Dehring, and Turnbull 2002; Menchik 1972). Studies suggest that when the benefits of experiencing natural scenery overwhelm the risk of flood, households are less likely to emphasize the potential threat from floods (Luttik 2000; Mahan, Polasky, and Adams 2000; Tobin and Montz 1988).

In addition, the local economy and labor markets are important contributors to young adults' residential location decisions; but the magnitudes of these effects are

generally small. Non-economic individual, household, and community factors play important roles in the process of home location (Garasky 2002). A good example is the contribution of place attachment to residential environment choice. The psychological bonds with a place, which are developed through an individual's habitual and satisfying everyday experience of the tangible or intangible surroundings of the place in which people are born, live, and die, contributes to residential environment choice (Feldman 1996; Deurloo, Clark, and Dieleman 1990). As Feijten and others (2008) state:

> Residential experience may influence people to return to places where they (or members of their household) previously lived because they still participate in activities there (activity), or because they may want to be closer to members of their social network (social), or because they know that place and value it in a positive way (awareness) (Feijten, Hooimeijer, and Mulder 2008).

People with urban and suburban residential experiences have been found to have a higher likelihood of return migration; people who have lived in rural areas prefer to move to another rural area (Feijten, Hooimeijer, and Mulder 2008). That is, people choose to relocate within residential environments that are similar to their original homes.

Some restrictions and opportunities, such as financial constraints and availability of dwellings (Feijten, Hooimeijer and Mulder 2008; Steinberg 2000) also influence residential preferences. Considering that so many contributors play roles in residential location selection, successful residential location choice has been viewed as a process of balancing tradeoffs among residence's accessibility, preference and characteristics of housing (Menchick 1972). Some households are willing to accept a longer commute to work if proximity to certain amenities (like monuments, historical buildings, lakes, rivers, and so on) is important to them (Chen 2007). Some households place greater importance on lower commuting costs and convenience and thus choose locations that allow access

to their job locations or to other urban activity centers (Greenwood and Hunt 1989). Others consider the functionality and spaciousness of the house itself to be more important than location (Kauko 2006a).

2.3 RESIDENTIAL LOCATION-RELATED RISKS

Because of the perceived benefits of environmental amenities, many households are willing to locate closer to their favorite environments, especially natural environments. In general, people either purposely ignore or are unaware of the negative aspects of attractive environments, when they decide to set down in a certain place after a series of tradeoffs. Dissonance theory has been applied to explain the psychological discomfort that arises from perceived residential hazards and benefits (Weinstein 1987a and b; Preston, Taylor, and Hodge 1983; Shippee, Burroughs, and Wakefield 1980). However, whether residents are aware of the potential hazards because of their residential location, once they moved in hazard-prone zones such as on floodplains, steep slopes, and ocean shorelines, they may suffer losses or damages caused by these disasters.

The impact of location-related natural risks on the values of residential real estate has been considered in the housing market. For example, the market capitalizes the risk of flooding into the value of residential property, resulting in a greater discounting of the price of property located within floodplains than outside of floodplains (Bin and Polasky 2004; Speyrer and Ragas 1991). However, previous studies in residential satisfaction have seldom considered the negative aspects of residential environments (except for safety from crime and crowding) in their explanatory models (Gomez-Jacinto and

Hombrados-Mendieta 2002; Bonnes, Bonaiuto, and Ercolani 1991; Lee and Guest 1983; Weidemann and Anderson 1982).

2.4 FLOODPLAIN DWELLING

With over six billion buildings located within the boundaries of the 100-year floodplain, flood losses in the U.S. are not only large, but have also been increasing dramatically (Burby 2001). Extensive development in flood-prone areas is a major reason for large and increasing losses from flooding[1]. So, why do people live in flood-prone areas? The incentives of floodplain occupancy in the U.S. were investigated four decades ago. Kates (1962) concluded that floodplain invasion derives from the economic benefits of floodplain occupancy overwhelming the potential hazards from floods. The economic benefits of floodplain occupancy are still believed to be the main reason for floodplain encroachment (Burby and others 1999).

The explanations for persistent residence in flood-prone areas (Fordham 1992, 71; Kates 1962, 135) are:

i. They (the flood-prone residents) do not know about the hazard and are therefore not unduly concerned.
ii. They know about the hazard, but do not expect a flood.
iii. They expect a flood, but do not expect to suffer a loss.
iv. They expect to suffer a loss, but not a serious one.
v. They expect to suffer a serious loss and have therefore undertaken, or are planning to undertake, some action to reduce the loss.
vi. They expect to bear a loss but see this outcome as an acceptable cost of enjoying the locational benefits.
vii. They had little or no choice where to live and have little or no choice but to stay.

Studies of floodplain occupation in peninsular Malaysia (Chan 1995) and in Bangladesh (Chowdhury 2003) find that reasons *v* and *vi* are two common reasons to answer the

[1] Land development increases impervious ground cover, which reduces the infiltration and increases runoff. Increased runoff increases the potential for flooding (Rogers and Defee II 2005). It has been found

question “Why do people live in the flood-prone areas?” Thinking about the geographical location, climate, and major economic patterns of Malaysia and Bangladesh, these reasons make sense. What is the answer to the same question in the United States?

To control floodplain development and to mitigate future flood damage over the United States, the National Flood Insurance Program (NFIP) was established with the passage of the National Flood Insurance Act of 1968. Economists believed that the costs associated with elevating buildings and upgrading levees to NFIP standards would shift development to flood-free locations (Lind 1967; Krutilla 1966). However, it has been found that NFIP building-elevation and insurance requirements have had little effect on the rate of increase in floodplain development (Frame 1998; Holway and Burby 1993). Burby (2001) found that the rate of development in flood-prone areas has increased at unprecedented rates over the past 30 years. Millions of dollars of new development poured into the flood-impacted areas after the great flood of 1993 in the upper Mississippi basin (Hipple, Drazkowski, and Thorsell 2005). A study of floodplain occupancy changes since 1958 finds that most of the study communities experienced increases in the number of structures in the floodplain (Montz and Gruntfest 1986). So, why do Americans live in flood-prone areas? What location-embedded benefits, including social and natural amenities, are perceived by residents who are living in the floodplain? Which location-related amenities are preferred and by whom? Do they even think about location-related risks in their search for their homes? These questions need to be answered.

2.5 SUMMARY

Studies of residential satisfaction, residential choice and preferences, and location-related risks have revealed the roles of household and housing characteristics and neighborhood on residential satisfaction. However, location-specified hazards have not been fully examined in terms of residential satisfaction, even though the market accounts for hazards and natural amenities in house prices and rents. So far, no study has examined floodplain residents' satisfaction of their home location considering both location-related benefits and location-related flood risks. No study has systematically investigated the environmental preferences of residents living in the floodplain. Scholars, policy makers, and floodplain managers have little concrete information about the location-embedded benefits desired by floodplain residents. Whether floodplain residents' residential location decisions are influenced by their social-economic and demographic characteristics is still unclear.

CHAPTER 3

RESEARCH STATEMENTS

This study examines residential satisfaction among floodplain residents. More specifically, it attempts to discern floodplain residents' attitudes toward their home locations, to determine the factors that contribute to their residential satisfaction, to identify residents' behavioral adjustments to perceived dissatisfactions with their residential environments, to understand their preferences for location-related features, to gauge their awareness of location-related risks, and to assess the impact of awareness on residential environment choice. This chapter presents a research procedure and discusses the research questions.

3.1 RESEARCH PROCEDURES

A flow diagram is provided to illustrate the relationships between residential satisfaction, responses to dissatisfaction with residential location, the importance of location-related characteristics in the search for new residential locations, and one's awareness of location-related hazards and the problems related to hazard awareness (Figure 3.1). The flow diagram consists of four components (A, B, C, & D) connected by solid lines that show direct connections and dashed lines that show indirect connections. The diagram emphasizes residential satisfaction and the factors that affect residential

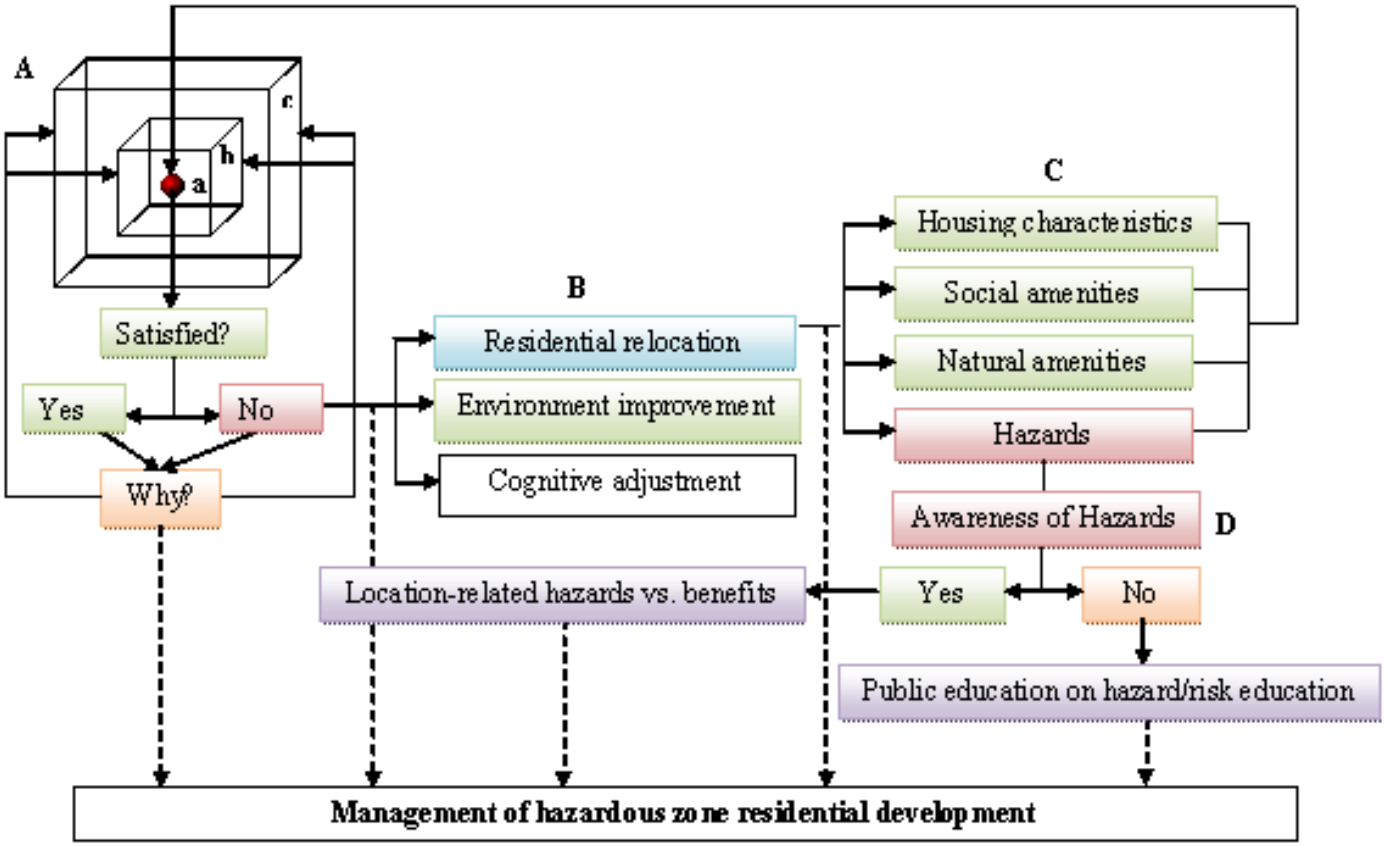


Figure 3.1 Residential Satisfaction, Preference and Awareness of Hazards

(a. residential satisfaction b. socio-economic and demographic characteristics of residents c. location-related characteristic)

satisfaction (A). The ball (a) representing residential satisfaction is encompassed by two cubes. The smaller cube (b) represents the socio-economic and demographic characteristics of residents. The larger cube (c) represents the perceived location-related characteristics, which include but are not limited to location-embedded social and natural amenities, housing characteristics, and hazards. The relationship between residential satisfaction and the two cubes represent factors that have been studied before (discussed in Chapter 2). No study, however, has analyzed the satisfaction of residents within hazardous areas in terms of socio-economic and demographic characteristics of the residents and location-related benefits and disadvantages. This study investigates what makes floodplain residents satisfied or dissatisfied with their residential location and the extent to which location-related factors contribute to the level of residential satisfaction. Residential satisfaction was measured at two different levels: in general and in hazard-specific conditions. The variables believed to be associated with general conditions are location-related social and natural amenities, location-related housing and hazards characteristics, and household socio-demographic characteristics. These variables are measured by specific operational variables (Table 3.1). The variables examined in hazard-specific conditions include perceived flood threats, actions to adjust to unsatisfactory residential environments, flood experiences, and factors involved in general condition.

The second component of the flow diagram (B) represents the current understanding of residential satisfaction generated primarily by migration studies. There are three typical responses to dissatisfaction with residential location: cognitive adjustments, environment improvements, and residential relocation (Amerigo and

Table 3.1 Operational Variables of Location-related Characteristics

Housing Characteristics
Satisfaction with visual attractiveness of your house/apartment
Satisfaction with price or rent you paid for your house/apartment
Satisfaction with size of your house/apartment
Location-related Social Amenities
Satisfaction with travel distance from your home to school/day care
Satisfaction with travel distance from your home to your/ your spouse's workplace
Satisfaction with travel distance from your home to retail stores
Satisfaction with travel distance from your home to health-care facilities
Satisfaction with neighbors (Do you feel comfortable living near them?)
Satisfaction with crime rate of your neighborhood
Location-related Natural Amenities
Satisfaction with view from house/apartment
Satisfaction with quietness of the neighborhood
Satisfaction with availability of nearby parks and green space
Satisfaction with availability of nearby natural recreation opportunities (tubing, fishing, boating, etc.)
Location-related Hazards Characteristics
Satisfaction with potential for flood damage or losses caused by flooding
Satisfaction with your capability to recover from flood losses
Satisfaction with cost of flood insurance for your house or property?

Aragones 1997; Knox 1987, 183-191; Galster and Hesser 1981; Spear 1974; Wolpert 1966). The latter two of these responses are examined more closely in this study. The results of the analysis will determine how likely floodplain residents are to take actions to protect their properties and themselves. Special attention is paid to residential relocation (C), specifically evaluating whether residents consider location-related housing characteristics, social and natural amenities, or hazards characteristics when finding a new home location. I strive to determine the relative importance of hazards in this process. For example, are they aware of location-embedded flood risk (D)? And what problems or consequences will come from residents' awareness (or lack thereof) of location-embedded hazards?

The aim of this diagram is to portray the logic of the study procedure. It shows the connections between residential satisfaction, residential mobility, and choice of residential environment. It also formulates objective targets for management of hazard-zone residential development. For example, if residents are unaware of location-related hazard characteristics, hazard management programs may need to improve residents' risk awareness. If location-related amenities attract residents to hazardous places, something must modify the attraction (perhaps by changing the location-related amenities or by modifying perception) and discourage development in these areas.

3.2 RESEARCH QUESTIONS

This dissertation addresses the following four research questions:

Question One: a. Are floodplain residents satisfied with their residential location? b. Why are they satisfied or dissatisfied with their location? c. What is the relationship between residential satisfaction and perceived location-related benefits and risks?

Research question one explores residential satisfaction and the possible contributors to residential satisfaction among floodplain residents. One documented reason for development in floodplains is that the public believes that economic or other benefits obtained from floodplain development outweigh the potential damages caused by floods (Burby and others 1999). However, the relationship between the location-embedded benefits and location-embedded risks is poorly understood. As Burby and others (1999) state, "homeowners and other decision makers do not fully understand the risk of loss from natural disasters, which they frequently perceive as lower than would have been warranted had they undertaken objective analyses of risk." This question addresses residents' satisfaction with their residential location taking into account the location-embedded benefits and location-embedded risk.

Floodplain residents were asked "Are you satisfied with your current home location?" They were expected to provide the reasons why they are satisfied or dissatisfied with the location of their homes by answering related survey questions. A list of location-related factors was provided for residents to evaluate the degree to which these factors contribute to their residential satisfaction (survey questions 1, 2, and 3). These location-related factors were selected from previous studies, which indicate that each of these factors is more or less related to residential location choices. The satisfaction ratings in concert with the operational variables (Table 3.1) were analyzed to

determine what made people satisfied or dissatisfied with their residences, and how the location-embedded benefits and risk influenced residential satisfaction.

Question Two: a. If residents are dissatisfied with their residential environment, what kinds of behavioral adjustments would they be likely to adopt? b. If residents want to relocate, what are the most important location-related characteristics they considered? c. Do people consider hazards in their residential evaluation?

Research question two strives to reveal residents' responses to residential-environment dissatisfaction. Attention is paid particularly to behavioral adjustments: improvements to either the house or landscape, and residential relocation. Once residents are dissatisfied with their residential environment and decide to move, they establish criteria for a preferred residential location. Which location-related characteristics are the most important? Some residents stress location-related social amenities (Greenwood and Hunt 1989), some address location-related natural amenities (Hui and others 2007), and others emphasize characteristics of the house or the residential lot (Kauko 2006a). This study put all of these together and attempts to determine the most important location-related characteristics. Survey respondents were asked to rate the importance of location-related characteristics in their search for new housing (survey question 5). Studies have shown that residents' home-location decisions are usually based more upon house or residential lot attributes and location-related benefits (Gao and Bhat 2007; Kauko 2006a; Yi 1985). However, because the study population is floodplain residents, location-embedded flood-related problems may have already impacted residents' daily lives. I expected that they would consider the location-related hazards characteristics in their

residential relocation processes. If people do consider location-related hazards, they can avoid losses from hazards by locating away from hazardous areas. It has been documented that global climate change and precipitation increases have only made a small contribution to the increasing flood losses (Pielke and Downton 2000), while extensive development of flood-prone areas is the most important cause (Mileti 1999). If everyone thought about the location-embedded risks and avoided living in hazardous places, there would be far less damage and fewer casualties from natural hazards.

Question Three: a. Were floodplain residents aware of the flood risk before they moved into the floodplain? b. Why do people who are aware of flood risk live in floodplains? c. What is the relationship between residents' awareness of flood risk and their satisfaction with location-related characteristics?

These research questions investigate residents' awareness of the flood risk, which differs from research question two which examines whether residents consider hazards in the process of residential location choice. The survey subject was asked: "Before you moved into your current residential structure (house, rented apartment, mobile home, etc.), were you aware that you were moving into an area where a flood might occur?" (survey question 6). If a survey respondent said "Yes," a set of choices to explain this why they were living in the floodplain were listed.

Risk or hazard awareness is an initial stage in motivating residents for the development and the application of appropriate disaster preparedness and risk-mitigating behaviors caused by extreme events (Karanci, Aksit, and Dirik 2005). Previous studies indicate that most people who live in hazard-prone areas are aware of location-related risks, such as forest fires, earthquakes, hurricanes, and floods (Blanchi and others 2006;

Collins 2005; Palm 1998; Cross 1990). In Kates' (1962) study, four out of five reasons used to explain why people live in areas subject to repeated floods indicate that people are aware of flood potential. Floodplain residents' awareness of flood risk in this study, however, was unexpected.

Why do people who are aware of flood risk still live in floodplains? Kates (1962) asked a similar research question almost half a century ago. This question is included here to gauge the effects of floodplain management policies on residents' attitudes toward floodplain locations. For example, the National Flood Insurance Program (NFIP) encourages communities to explore nonstructural approaches to flood management, such as land-use planning and the flood-proofing of buildings. Following the massive floods of 1993 in the Upper Mississippi River and the lower Missouri River basins, the NFIP was amended significantly in 1994 to encourage local governments and floodplain property owners' to mitigate flood risk (Burby 2001). In addition, the improved understanding about global climate change, population growth, and urbanization may also have influenced people's attitudes toward floodplains living (White, Kates, and Burton 2001).

Research question three also examines the relationship between residents' awareness of flood and their satisfaction of location-related characteristics. Is there any difference in location satisfaction between residents who are aware of the flood risk and those who are unaware of the flood risk?

Question Four: a. Are floodplain residents willing to accept higher flood risk to be closer to some desired location-related benefits? b. How do perceived floods,

behavioral adjustments, flood experiences, location-related characteristics, and socio-economic characteristics influence the choice between higher risk and higher benefits?

Research question four examines the relationship between the acceptance of higher flood risk and location-related benefits. Previous studies point out that residents are willing to sacrifice less desirable location-related factors in order to gain more desired location-related factors (Chen 2007; Colwell, Dehring, and Turnbull 2002; Menchik 1972). If residents enjoy the cultural or economic ambiance of the central business district (CBD), for instance, they would live in the CBD and accept a longer commute to work (Chen 2007). A study of the demand for outdoor recreation and the choice of primary residential location find that the stronger the desire for recreation, the greater the attraction of recreation sites and the lower the demand for other goods, including the quality of house (Colwell, Dehring, and Turnbull 2002). These examples suggest that people appreciate location-specific irreplaceable factors rather than replaceable ones. Research question four examines whether floodplain residents view a higher flood risk as an acceptable cost of enjoying the location-related benefits. The following two survey questions were asked: Would you accept a higher risk of flooding in order to be closer to the natural amenities (such as natural views and proximity to outdoor recreation) of a residence location? And, would you accept a higher risk of flooding in order to be closer to social amenities (such as a shorter commute to work, friendly neighbors, proximity to a school or other public facilities, etc.) of residence location?

The answers should be related to residents' residential location choice preferences. If residents think the location-specific natural amenities are more important to them, they may accept a higher risk of flood. This is understandable as water-related natural

amenities and flood risk are strongly linked. Starr's study (1969) suggests that if people are willing to participate in a risky behavior they are more likely to accept the negative consequences than are those who are unwilling to do it. On the other hand, if residents emphasize the location-specific social amenities, they may be less likely to accept a higher flood risk because location-related social amenities such as proximity to public facilities or workplace are replaceable amenities.

CHAPTER 4

STUDY AREA

San Marcos is the county seat of Hays County, Texas, and is located about halfway between Austin and San Antonio (Figure 4.1). As a Sunbelt city, San Marcos has experienced a fast population growth over the last forty years. Its population was 18,900 in 1970 (Earl and Wood 2002) and 28,743 in 1990. By 2000, the population had increased to 34,733. The estimated population in 2006 was 47,181 (US Census 2008). The most significant contributor to the increasing population of the city is the rapid growth of enrollment at Texas State University-San Marcos. The total student population was 9,900 in 1970, 20,652 in 1997, and 28,121 in 2007 (Texas State 2007). San Marcos is also known for many recreational attractions, shopping opportunities, and the San Marcos River.

The San Marcos River begins at San Marcos Springs which bubble up from the bottom of Spring Lake, an area of artesian outflow from the Edwards Aquifer along the Balcones Escarpment. There are more than 200 springs flowing from three large fissures and other smaller openings in the rock, and they are the second largest springs in Texas (Greene 2007; Texas State Historical Association 2005; Barkley 1970). A dam was constructed in 1849, inundating the springs and their surrounding areas to form Spring

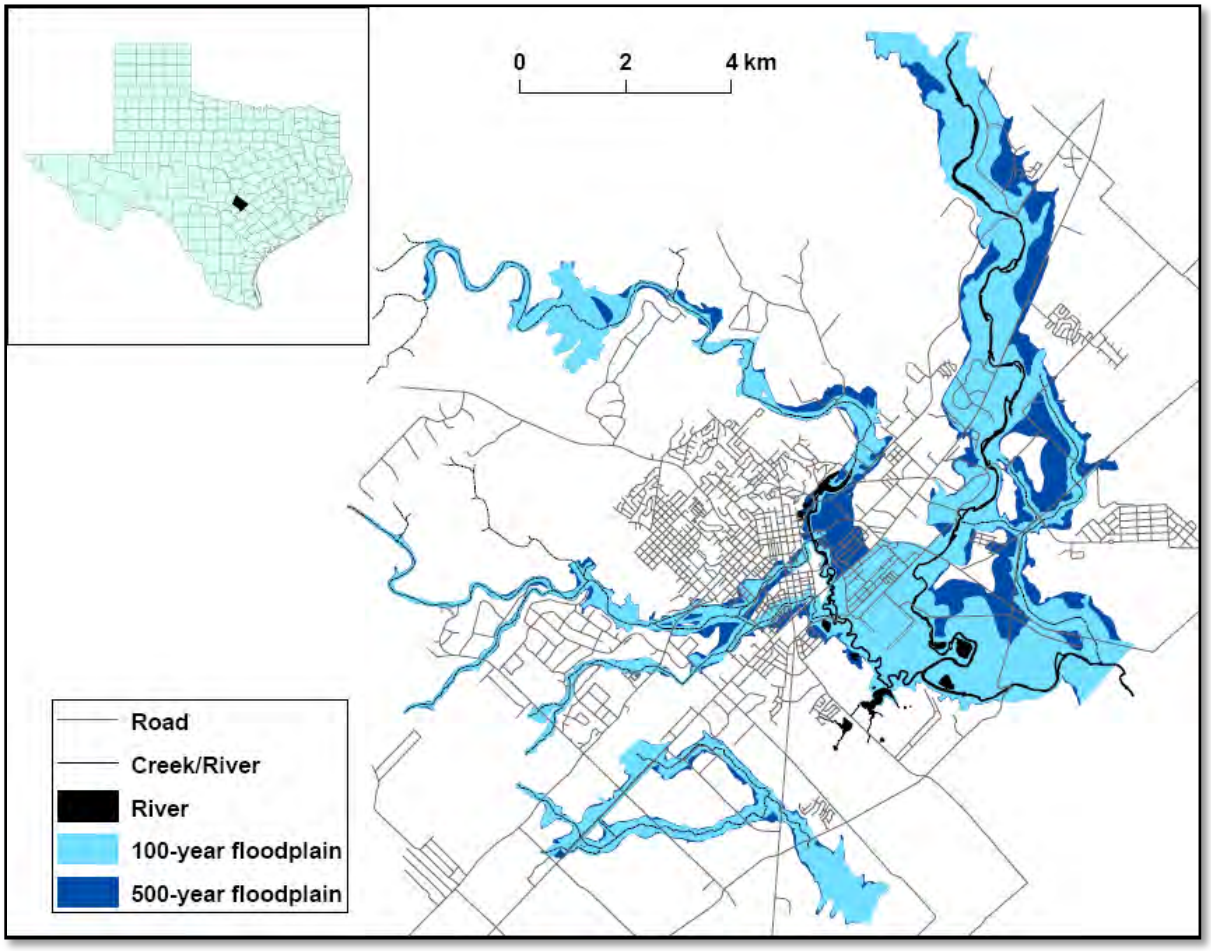


Figure 4.1 Study Area-San Marcos, Texas

Lake. Above the dam, a drainage area of about 100 km^2 contributes runoff to the lake and to the San Marcos River (Figure 4.1) although the San Marcos River officially begins at the springs. The San Marcos River joins the Blanco River approximately three km southeast of Interstate Highway 35, the main highway through San Marcos, and flows approximately 190 km through heavily wooded banks to join the Guadalupe River (Texas Parks and Wildlife Department 2007). The San Marcos River is one of the most popular recreational rivers in Texas. It draws more than five hundred thousand visitors for water-based recreational and civic activities every year (Earl and Wood 2002). The river is also noted for its unique plant and aquatic animal life. It is home to four federally listed endangered species (Wikipedia 2008). The City of San Marcos has called for protection of the San Marcos River for its aesthetic and recreational values (City of San Marcos 1996).

Due to the flow of moisture from the Gulf of Mexico and the orographic effect of the Balcones Escarpment, central Texas is known to experience frequent heavy rainfall events (Slade and Patton 2003). Along with the runoff from the Edwards Plateau above the Balcones Escarpment, the San Marcos River also has the potential for generating huge flood discharges. A flood in May 1970 drowned two people and the city was declared a federal disaster area and about 1,800 people were evacuated from the flood of June 13, 1981 (Earl and Wood 2002). These catastrophic events called for flood control projects across the upper San Marcos watershed. Over the past several decades, flood control dams have successfully reduced the uncontrolled drainage area, but floods continue to cause impressive damages (Earl and Wood 2002). For example, although the October 1998 flood was the event of record for San Marcos, the flood discharge in the

San Marcos River only reached the equivalent of a 25-year flood (Adamietz 1999, 10). In spite of that, the flood still affected more than 500 buildings, and 68 of them were destroyed or seriously damaged; preliminary estimates put the loss in San Marcos at $12,000,000 (Adamietz 1999, 12). The population growth of San Marcos and Texas State has occurred within the San Marcos River watershed (Pulich, Perry and German 1994). Development of watersheds, especially through urbanization, is a major contributor to increases of runoff and frequency of flooding (Rogers and Defee II 2005; Scheuler 1994). Therefore, flood protection is a challenging task.

In addition to the San Marcos River, the Blanco River and Purgatory Creek watersheds are other main sources of flooding in San Marcos (City of San Marcos 2008). In November of 2001, the Blanco River flooded within an hour of the onset of a thunderstorm and hundreds of people were evacuated away from flood-prone areas (National Climate Data Center 2001). Purgatory Creek flows from near the Devil's Backbone geological feature in eastern Comal County to the southeast for about 20 miles, crossing the Balcones Escarpment and contributing to the San Marcos River. During heavy rains, Hopkins Street is often closed due to flooding (Wikimapia 2008). To mitigate residential flood risk in the San Marcos area, the city has hired a consultant to study and identify drainage and flooding problems in the area and provide flood mitigation alternatives. One proposed structural flood mitigation to the Blanco River is the construction of a $64 million flood channel measuring 300-feet across and 12-feet deep (Georgiou 2008). The structural alternative offered for Purgatory Creek includes culvert improvements at Hopkins Street and maintenance of the channel of the creek (Georgiou 2008). Non-structural flood mitigation alternatives include buyouts of flood-

prone properties, additional regulatory controls for the development in these areas, improvement of flood warning systems, reverse 911 calling, and others (Georgiou 2008). The adoption of the proposed flood alleviation alternatives will be decided by the San Marcos City Council.

CHAPTER 5

METHODS

This chapter describes the methods used in this study as they pertain to survey design and data-analysis. The first section of this chapter identifies the purpose of each of the survey questions, the selection of survey participants, and survey procedures. Since most variables involved in this study are measured by nominal or ordinal scales, I selected several categorical data-analysis methods. The second section of this chapter outlines these statistical techniques.

5.1 THE DESIGN OF SURVEY

The survey addresses residents' satisfaction with and preferences for their home location, awareness of flood risk and exposure, their estimates of the probability of future flooding, attitudes toward proximity to hazard-prone areas and location-related amenities, and social-demographic characteristics of survey respondents (Appendix B). Considering the size of the Spanish-speaking population in the study area[2], the survey questionnaire was provided in English and Spanish. The survey instrument was approved by the Institutional Review Board at Texas State before it was conducted.

[2] According to the American Community Survey 2003 data profile, 21 percent of the total population lives in Austin-San Marcos MSA spoke Spanish at home. Reference: http://www.census.gov/acs/www/Products/Profiles/Single/2003/ACS/Tabular/380/38000US06402.htm Accessed on January 14 of 2008.

5.1.1 Questionnaire

Residents' satisfaction with their home location is addressed by questions 1, 2, 3 and 17 in the survey designed for this study. The first question asks whether survey participants are satisfied with their home location. Responses to this question were assumed to reflect residents' general opinion of their home locations. Since many questions in the survey concern the survey participants who are currently living within a floodplain and are exposed to floods, question 17 provides another chance for survey participants to evaluate their satisfaction with their home location. It is expected that the responses to question 17 will reflect residents' concern on both location-related benefits and risks when evaluating their satisfaction with their home location.

The second survey question is open-ended. It asks respondents why they are satisfied or dissatisfied with their home location. Responses to this question are used to determine what makes people satisfied or dissatisfied with their home location. Question 3 asks respondents to rate their satisfaction with 16 location-related factors. These location-related factors have been selected from the existing literature; each of them plays a role in residential-location decisions.

The fourth question asks respondents if they plan to move from their current location. The purpose of this question is to determine whether people who are dissatisfied with their location are more likely to relocate. Survey question 9 asks respondents whether or not they plan to move to a non-flood-prone area. A comparison of responses to question 4 and question 9 will reveal whether the respondents' planned relocations are related to their dissatisfaction with their current home locations because of the potential for flooding.

Survey question 5 measures residential environment preferences. Seven location-related issues were selected to represent four location-related characteristics (social amenity, natural amenity, hazard/risk, and housing).

Respondents' awareness of flood risk and exposure are measured by survey questions 6, 7, and 21. Questions 8 and 12 examine residents' preparation for future floods. Survey questions 10 and 11 investigate respondents' flood experiences. Questions 13, 14, 15, and 16 ask respondents to estimate the probability of future flooding of their homes, areas around their residences, neighborhoods, and their community. Floodplain residents' attitudes toward proximity to risk-prone areas and location-embedded benefits are examined by survey questions 18 and 19. Question 20 examines residents' attitudes about who should take responsibility to reduce the damage from flooding. Survey questions 22 through 31 ask respondents for socio-demographic information. And finally, survey question 32 is open-ended, allowing participants to provide comments and suggestions about the survey.

5.1.2 Survey Participants

Survey participants were randomly selected from the residents living within the 500-year floodplain in San Marcos, Texas (Figure 5.1). Survey participants were informed that participation in this study was voluntary. An on-site gift was presented as a token of appreciation to the potential survey respondents to encourage them to participate in the survey. To ensure the highest possible response rate, participants who completed and returned the survey questionnaire were eligible to win a $100 cash prize.

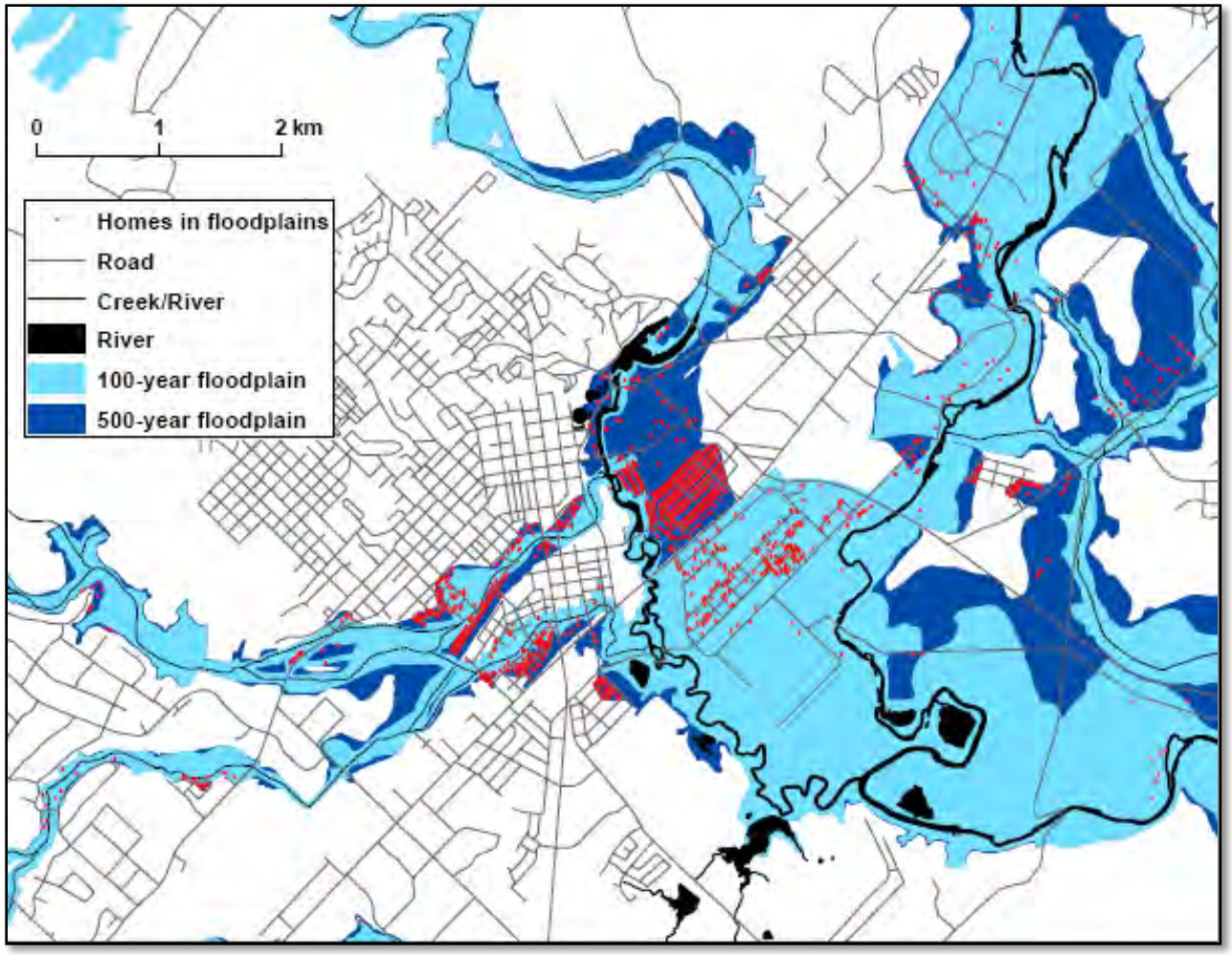


Figure 5.1 Building Addresses within the 500-year Floodplain, San Marcos, Texas

A total of 319 survey addresses (Figure 5.2) were randomly selected from about 1,800 building addresses within the 500-year floodplain[3]. Besides the list of 319 survey addresses within the 500-year floodplain, two lists of alternative samples were also used. One was derived from the building addresses in the 100-year floodplain. The other was obtained from the building addresses outside of the 100-year floodplain but within the 500-year floodplain. When selected survey participants from the original 319 samples refused to participate or returned an incomplete survey questionnaire, nearby neighbors from the alternative lists were invited to participate in the survey as replacements.

5.1.3 Survey Procedures

I delivered the survey questionnaire door-to-door. There are reasons why I decided to deliver the survey by myself. First, it allowed me to introduce the purpose and importance of the study to potential survey respondents face-to-face. The conversation helped residents to understand the significance of the study and the way in which they could help. Second, handing out the survey personally also provided a chance for me to answer questions or concerns that survey respondents might have had. Third, my presence was helpful to those who had difficulty reading, understanding, or filling in the survey. Fourth, it was a good opportunity for me to observe the study-area environment. Finally, it was more economical to conduct the research in this fashion. When the

[3] Data were obtained from the Environment and Engineering Department at City of San Marcos, Texas.

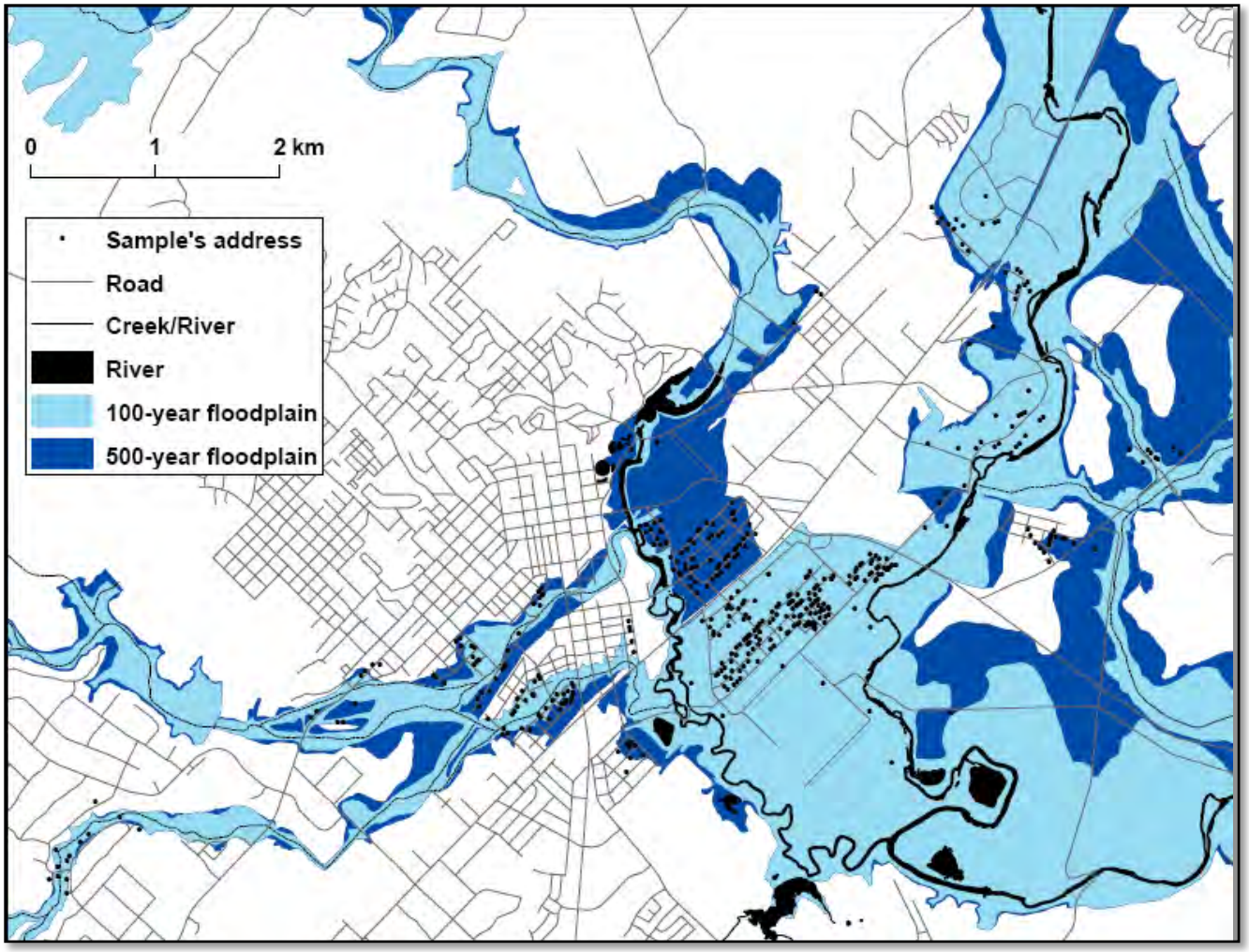


Figure 5.2 Selected Survey Participants' Addresses, San Marcos, Texas

originally selected survey participants declined the invitation, a survey packet was ready for a neighbor, so no resources were wasted. The survey packet included a cover letter, a questionnaire, a token gift of appreciation, and a postage-paid return envelope. The cover letter (Appendix A) explained the purpose and importance of the survey. It also guaranteed confidentiality in the treatment of the data.

Initially 319 survey questionnaires were delivered. A total of 90 questionnaires were returned for a response rate of 28 percent. To improve the response rate, another 217 survey questionnaires were distributed to residents who said they would participate in the survey but failed to return the questionnaires. If residents were no longer interested in the study during the second delivery, a neighbor was asked to participate in the survey. The final response rate of the survey was 29 percent[4], but not all returned questionnaires were complete (i.e. contained answers to all 32 survey questions) (Figure 5.3). Responses with missing value were removed from data analysis when necessary. Only valid answers were included in the data analysis. For example, if respondents did not answer the first question but answered all others, their responses were excluded from analysis of question one, but their responses to other questions were included and analyzed.

5.2 DATA ANALYSIS TECHNIQUES

The variables being studied in this research are measured either on nominal or ordinal scales. Therefore, categorical data analysis methods were applied in this study.

[4] A total of 742 household were visited, 536 survey questionnaires were delivered, and 159 questionnaires were returned.

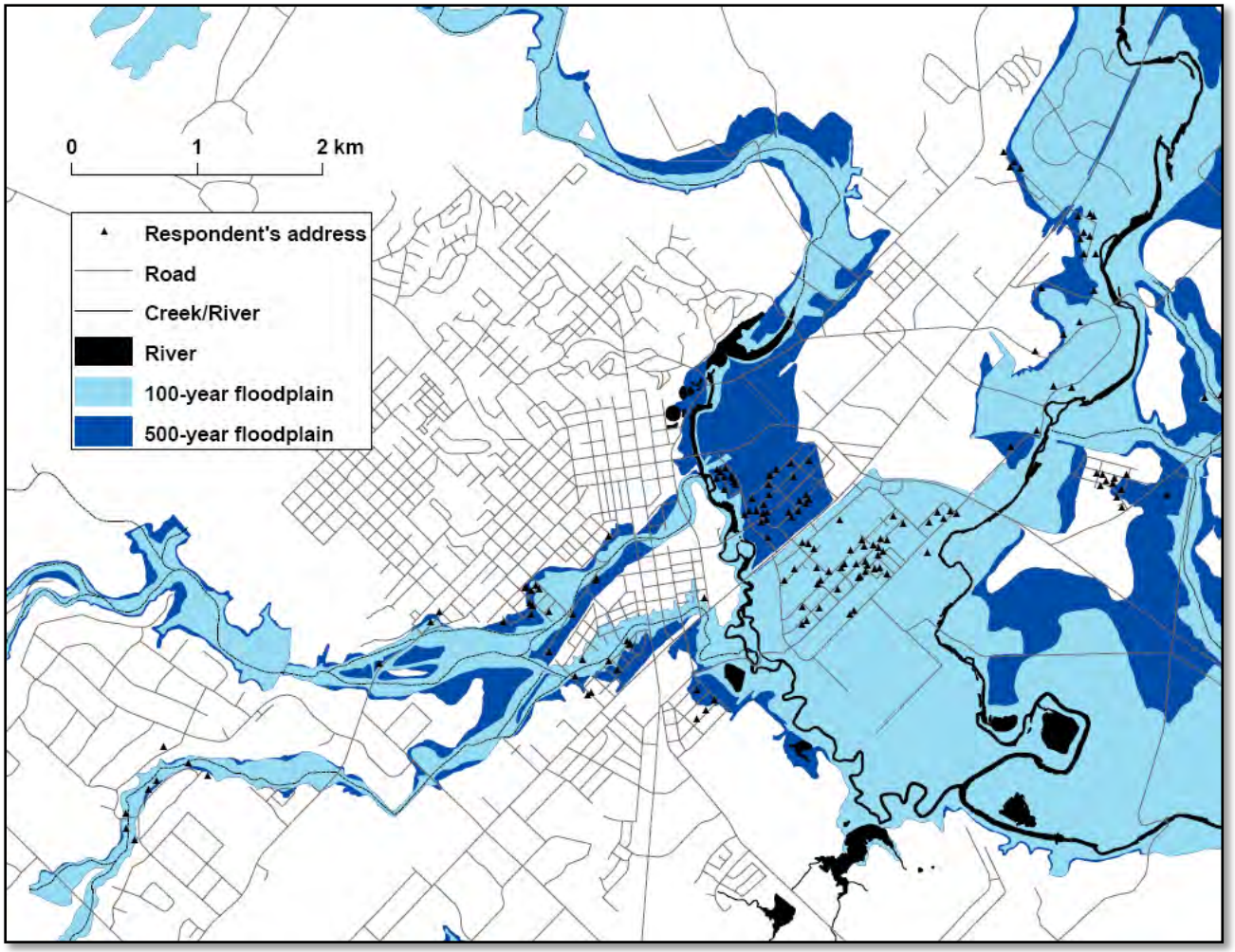


Figure 5.3 Survey Respondents' Addresses, San Marcos, Texas

The following section describes the proportion test, chi-square test, Mann-Whitney U-test, ordinal regression, and logistic regressions. These statistical techniques were used in data analyses because they met the assumptions of nonparametric data and helped to answer the research questions.

5.2.1 Statistical Test for Population Proportion

Equation 5.1 is used to make inferences about the proportion of people favoring a particular issue (Fleiss, Levin, and Paik 2003, 26-30; Agresti 1996, 10-12):

$$P' = \frac{X}{N} \qquad (5.1)$$

Where P' is the sample proportion, X is the size of the population who are in favor of a particular issue, and N is the sample size.

As the sample size N increases, the sample proportion p' tends to approach the true unknown population proportion P. The procedure for the proportion test (one-tailed test) is summarized below:

1) Determine the null and alternative hypotheses:

   Null hypothesis H_0: $P' = P_0$

   Research hypotheses: H_1: $P' > P_0$ or H_1: $P' < P_0$

   where P_0 is a pre-specified population proportion, P' is the sample proportion.

2) Decide the level of significance α and the value of z_{α}.

3) The value of test statistic z_{obs}:

$$Z_{obs} = \frac{(P^{'} - P_0)}{\sqrt{\frac{P_0 \times (1 - P_0)}{N}}} \qquad (5.2)$$

where P_0, P',, *and* N are same as Equation (5.1).

4) Check whether to reject the null hypothesis by comparing the value of z_{obs} to specified value of z_α. If $z_{obs} > z_\alpha$, reject null hypothesis, H_0, and accept research hypothesis, H_1: $P' > P_0$; If $z_{obs} < -z_\alpha$, reject null hypothesis, H_0, and accept research hypothesis, H_1: $P' < P_0$.

5) Interpret statistical results. Acceptance of research hypothesis H_1: $P' > P_0$ suggests that at least P_0 population proportion who are in favor of a particular issue; while acceptance of research hypothesis H_1: $P' < P_0$ suggests at most P_0 population proportion who are in favor of a particular issue.

In this study, I used the proportion test to find the upper-limit and lower-limit proportions of residents living in the floodplain under different conditions: 1) planning to move out (survey question 4); 2) being aware of the risk of flood (survey question 6); 3) threatened by risk of floods (survey question 7); 4) have taken actions to prevent damages from floods (survey question 8); 5) have an intention to relocate to a non flood-prone area (survey question 9); 6) have been flooded (survey questions 10 and 11); and 7) have flood insurance (survey question 12).

The pre-specified significance is $\alpha = 0.05$, so the critical value is $z_\alpha = 1.645$. The value of specified population proportion (P_0) is based on the value of sample proportion (P').

5.2.2 Chi-Square Test and Association Coefficients

The chi-square test for independence was also used, for example, to measure the association between residents' flood awareness and preference for natural or social amenities, or between residents' flood awareness and locational satisfaction. Chi-squared tests simply indicate the dependence between two variables. I measured the strength of the association between variables by computing the contingency coefficient (Ott and others 1991, 336-419; Reynolds 1984, 15-30). The contingency coefficient is computed as Equation 5.3 (Ott and others 1991, 336-419):

$$C = \sqrt{\frac{X^2}{N + X^2}} \qquad (5.3)$$

where X^2 is the observed value of the chi-square test and N is total sample size.

The contingency coefficient is between 0 and 1, 0 reflects that there is no association between variables, and 1 means that there is a perfect association between variables. Because some of the disadvantages of the contingency coefficient[5], Cramer's V was employed as a second measure of association for the relevant variables. The V is defined as Equation 5.4:

$$V = \sqrt{\frac{X^2}{N \times t}} \qquad (5.4)$$

where X^2 and N are the same as in Equation 5.3 and t is the smaller value of r - 1 and c – 1; r and c are the number of rows and columns of the datasets, respectively (Ott and others 1991, 336-419).

[5] Please see Ott and others (1991, 376) for the detailed information about the disadvantages of contingency coefficient.

Gamma, Kendall's tau-b and Kendall's tau-c are used to measure the association for ordinal variables. These coefficients range between -1 and 1. Values close to an absolute value of 1 indicate a strong relationship between the two variables, and values close to 0 indicate little or no relationship. The sign of the coefficient indicates the direction of the relationship. Coefficient Kendall's tau-c ignores ties but Kendall's tau-b counts ties (Agresti 1996; Liebetrau 1983).

5.2.3 Mann-Whitney U-Test

The Mann-Whitney test was used to compare people's satisfaction with their home location considering their flood-risk awareness. Survey respondents were divided into two groups according to their awareness of flood risk: floodplain residents who are aware of the risk (group X), and those who are unaware of the risk (group Y). There are four location-related characteristics in this study: natural amenities, social amenities, hazard-related issues, and housing. Hypotheses were constructed around these four features. For example, using satisfaction with location-related natural amenities, the hypothesis is that residents who are aware of flood risk and live in the floodplain are more satisfied with the natural amenities than those who are unaware of the risk of flood (H_1: $M_X > M_y$). The null hypothesis is that residents who are aware of flood risk are equally or less satisfied with the natural amenities than those who are unaware of the risk of flood (H_0: $M_X \leq M_y$). The test statistic is

$$z = \frac{U - n_x n_y / 2}{\sqrt{n_x n_y (n_x + n_y + 1)/12}} \qquad (5.5)$$

$$U = n_x n_y + \frac{n_x(n_x + 1)}{2} - T_x$$

where T_x is the sum of the ranks assigned to the sample X, n_x and n_y are sample size of X and Y (Daniel 1990, 90-97), at a given significance level $\alpha = 0.05$, the critical value of $z_\alpha = z_{0.05} = 1.645$. The null hypothesis H_0 is rejected if the computed z is greater than 1.645.

5.2. 4 Ordinal Regression

Since the major survey questions (questions 1, 3, and 17) provided ordinal categorical responses, ordinal regression was used to estimate the importance of factors that predicate residents' attitudes toward their home location. Ordinal regression is an extension of the generalized linear model, which can be used to answer a wide range of statistical questions (Norusis 2003 and 2005). The generalized linear model is defined in Equation (5.6):

$$\text{link}(\gamma_j) = \frac{\theta_j - [\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k]}{\exp(\tau_1 z_1 + \tau_2 z_2 + \ldots + \tau_m z_m)} \qquad (5.6)$$

where $\gamma\gamma_j$ is the cumulative probability for the *j*th category, $\gamma\theta_j$ is the threshold for the *j*th category, $\beta_1 \ldots \beta_k$ are the regression coefficients, $x_1 \ldots x_k$ are the predictor variables, and *k* is the number of predictors. The numerator on the right side determines the location of the model. The denominator of the equation specifies the scale. The $\tau_1 \ldots \tau_m$ are coefficients for the scale component and $z_1 \ldots z_m$ are *m* predictor variables for the scale component (chosen from the same set of variables as the *x*s). The scale

component accounts for differences in variability for different values of the predictor variables. To keep the model simple, in this study, I did not include the scale component in the model.

The link function is a transformation of the cumulative probabilities that allows estimation of the model. Five link functions are provided in the ordinal regression procedure in SPSS (Table 5.1). I selected complementary log-log and logit two link functions to compare the efficiency of the regressions and to select one of them according to the model-fitting information.

5.2.5 Logistic Regression

Logistic regression is used when the dependent variable is dichotomous and the independents are of any type[6]. For a dichotomous response Y with values of 1 and 0, the logistic model focuses on how the natural log of the odds that Y = 1 varies when predictor X takes values x. Denoting the probability that Y = 1 as $\pi(x)$ (Agresti 1996; 103-144), the logistic regression model describes the relationship between logit $[\pi(x)]$ and a set of predictors X as

$$\text{logit}[\pi(x)] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \quad (5.7)$$

An alternative equation that converts logit $[\pi(x)]$ back to the odds by exponentiation is

[6] Multinomial logistic regression exists to handle the case of dependents with more classes than two, see Menard (2002, 80-91) for more information.

Table 5.1 Link Function of Ordinal Regression

Function	Form *	Typical application
Logit	$\log(\gamma / (1- \gamma))$	Evenly distributed categories
Complementary log-log	$\text{Log}(-\log(1- \gamma))$	Higher categories more probable
Negative log-log	$-\log(-\log(\gamma))$	Lower categories more probable
Probit	$\Phi^{-1}(\gamma)$	Latent variable is normally distributed
Cauchit (inverse Cauchy)	$\text{Tan}(\pi(\gamma -0.5))$	Latent variable has many extreme values

*The symbol γ represents the probability that the event occurs.

$$\pi(x) = \exp(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k) / (1+\exp(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)) \quad (5.8)$$

Logistic regression can be used to predict a dependent variable, to determine the percentage of variance in the dependent variable explained by the independents, to rank the relative importance of independents; to assess interaction effects, and to understand the impact of covariate control variables (Menard 2002; Pampel 2000). In this study, logistic regression was used to assess residents' preferences between locational amenities and acceptance of a higher flood risk. The dependent variables are residents' expressed willingness to accept a higher chance of flood risk in order to be closer to location-related natural or social amenities (survey questions 18 and 19). The independent variables included perception of flood risk, preparation of the risk, flooding experiences, location-related features, and social-demographical characteristics.

CHAPTER 6

RESULTS OF SURVEY

This chapter reviews and discusses the results of survey by using descriptive statistics. Specifically, I describe the composition of the survey respondent population, the levels of satisfaction and dissatisfaction with home location, preference for residential environment, perceptions of flood risks, flood experiences, mitigation and preparation for future floods, and the apparent trade-offs between flood risk and amenities.

6.1 SOCIAL DEMOGRAPHIC INFORMATION OF SURVEY RESPONDENTS

Table 6.1 shows social demographic characteristics of survey respondents. Females are predominant among survey respondents (62 %). The average age of respondents is 46 years. The younger (age: 18-25 years) and elder (age: 65 years old or above) group population account for 11 percent and 14 percent of total respondents, respectively. Nearly 40 percent of respondents graduated from high school and about 46 percent of residents attended college. The average number of years of education year is 13.7. Nearly 60 percent of respondents were employed full-time and retired respondents comprised 20 percent of the total survey respondents. About 60 percent of survey respondents reported that their household income in 2006 was less than $40,000. White

Table 6.1 Survey Respondents Socio-demographics

Elements		All respondents Count (%)	In downtown Count (%)	In Suburban Count (%)
Sex	Female	97 (62 %)	74 (60 %)	23 (70 %)
	Male	60 (38 %)	50 (40 %)	10 (30 %)
Age (years)	Less than 26	17 (11 %)	13 (11 %)	4 (13 %)
	26 - 45	59 (38 %)	50 (41 %)	9 (28 %)
	46 – 65	54 (36 %)	40 (33 %)	14 (44 %)
	Older than 65	23 (14 %)	18 (15 %)	5 (16 %)
Education	K-8	9 (5 %)	8 (7 %)	1 (3 %)
	9-12	57 (38 %)	50 (41 %)	7 (22 %)
	College	70 (46 %)	53 (44 %)	17 (53 %)
	Graduate	17 (11 %)	10 (8 %)	7 (12 %)
Employment	Full-time employee	85 (58 %)	72 (58 %)	13 (40 %)
	Retired	31 (20 %)	21 (17%)	10 (30 %)
	Part-time	14 (10 %)	9 (7 %)	5 (15 %)
	Student	12 (8 %)	11 (9 %)	1 (3 %)
	Inactive	15 (10 %)	11 (9 %)	4 (12 %)
Income (K)	Less than $40	83 (60 %)	70 (60 %)	13 (42 %)
	$40-$59.9	30 (21 %)	23 (20 %)	7 (22 %)
	$60-$79.9	18 (13 %)	15 (13 %)	3 (10 %)
	$80-$99.9	11 (8 %)	4 (4 %)	7 (23 %)
	More than $100	3 (2 %)	2 (2 %)	1 (3 %)
Ethnic	White	75 (48 %)	50 (40 %)	25 (74 %)
	Hispanic/Latino	76 (48 %)	67 (54 %)	9 (26 %)
	African-American	1 (0.5 %)	1 (0.8 %)	N/A
	Other	6 (2.5 %)	6 (5 %)	N/A
Ownership of home	Owner	106 (68 %)	78 (63 %)	28 (85 %)
	Non-owner	51 (32 %)	46 (37 %)	5 (15 %)
Home type	Single family	124 (79 %)	96 (77 %)	28 (82 %)
	Mobile home	15 (10 %)	15 (12 %)	N/A
	Apartment	10 (6 %)	6(5 %)	4 (12 %)
	Other	9 (6 %)	7 (6 %)	2 (6 %)
Child(ren)	Yes	67 (43 %)	51 (41 %)	16 (49 %)
	None	90 (57 %)	73 (59 %)	17 (52 %)
Pet(s)	Yes	101 (64 %)	79 (64 %)	22 (65 %)
	None	57 (36 %)	45 (36 %)	12 (35 %)

and Hispanic/Latino are the dominated ethnic groups. Homeowners accounted for 68 percent of survey respondents. Most of the survey respondents lived in their own homes (79 %). Less than half of survey respondents have at least one child; while 64 percent of respondents have at least one pet (Table 6.1). Residents living in suburban areas are in general, better educated and have higher household incomes compared to their counterparts in more urban portions of the study area. Also, the proportions of white population, home owners, living in single-family structures, and living without young children (12 years old or younger) are higher among residents living in suburban than those in downtown[7] (Table 6.1).

6.2 SATISFACTION WITH HOME LOCATION

Residents were asked to rate their satisfaction with their home location from very satisfied to very dissatisfied at the beginning of the survey (question 1). The returned survey questionnaires indicate that most residents (86 percent) felt either slightly or very satisfied with their home locations; only 8 percent of residents were dissatisfied. The rest of respondents (6 percent) found it difficult to say whether they were satisfied or dissatisfied with their home locations. "A flood area," "too much traffic," and "mosquitoes" were major reasons for dissatisfaction with their home locations. Respondents who could not express their feelings about their home locations mentioned both location- related advantages and disadvantages. For example, they wrote, "(It is)

[7] The sample size of floodplain residents in suburban areas is so small that I do not intend to divide the sample into downtown and suburban to conduct statistical analysis.

close to shopping area but too many rental houses," "too many apartments, flooding area, and too much traffic," or "it is in the middle of everything but the size of the home is too small." The explanations for satisfaction varied from the convenience of the location and access to important things, quietness of neighborhoods, and to place attachment. The convenience of the location is the most frequently mentioned reason for residential satisfaction. Respondents wrote, "It's centered in the midst of everywhere" or "Everything is convenient for us…" The second most cited reason for satisfaction is the quiet and peacefulness of the neighborhood. Place attachment was mentioned primarily by long-term residents. One elderly lady said, "(I have) lived here 44 years. This is my home." Another long-term resident who had lived there for more than 25 years was satisfied with their home location, but complained about the frequent street flooding. Answers to survey question 17 indicate that 76 percent of floodplain residents were satisfied with their home location, 7 percent of residents were dissatisfied, and the rest 17 percent residents were unsure about their satisfaction with their home location. Question 17 asks residents to rate their home-location satisfaction after answering a number of questions that designed to remind them of flooding problems with their home. Comparing the responses of questions 1 and 17, it is apparent that the perception of flooding problems affected residents' satisfaction ratings. When residents were forced to consider location-related flood issues, residential satisfaction went down by10 percent, at the same time, the percentage of neither satisfied nor dissatisfied increased to 17 percent although the levels of dissatisfaction did not change too much (1 percent). A comparison of responses to questions 1 and 17 indicates that residents feel more satisfied with their home location in general; but the perceived residential satisfaction goes down when

location-related hazards are concerned in rating residential satisfaction (Figure 6.1). A chi-square test indicates that the responses to questions 1 and 17 are significantly associated ($\chi^2 = 118.61$, $\alpha = 0.05$). The Kendall's tau-b and tau-c values are 0.403 and 0.307, respectively. These results indicate that the responses to questions 1 and 17 are positively associated. Residents' attitudes toward individual factors, which influence home-location satisfaction, indicate that residents in general are satisfied with location-related natural and social amenities as well as house features, but are less satisfied with location-related flooding and hazard-related issues (Table 6.2).

6.3 IMPORTANT LOCATION CHARACTERISTICS

Survey respondents were asked to rank seven location-related features, which might be considered in the process of searching for a residential location (question 5). The results indicate that characteristics of the housing were the most important factors influencing residential location choice (Table 6.3). Social amenities of their home locations were the second important factors to be seriously considered. Being located closer to workplaces, schools, and other indispensable places was more important than being closer to friends, family, and other social relationships (Table 6.3). Home location-related natural amenities were less important to residents than the house's characteristics or social amenities. Access to scenic views, green space, clean air, quiet surroundings, and other natural features have been viewed as more important than being closer to outdoor recreation. Exposure to location-embedded hazard and hazard-related issues were the least important features considered in residential location decisions (Table 6.3).

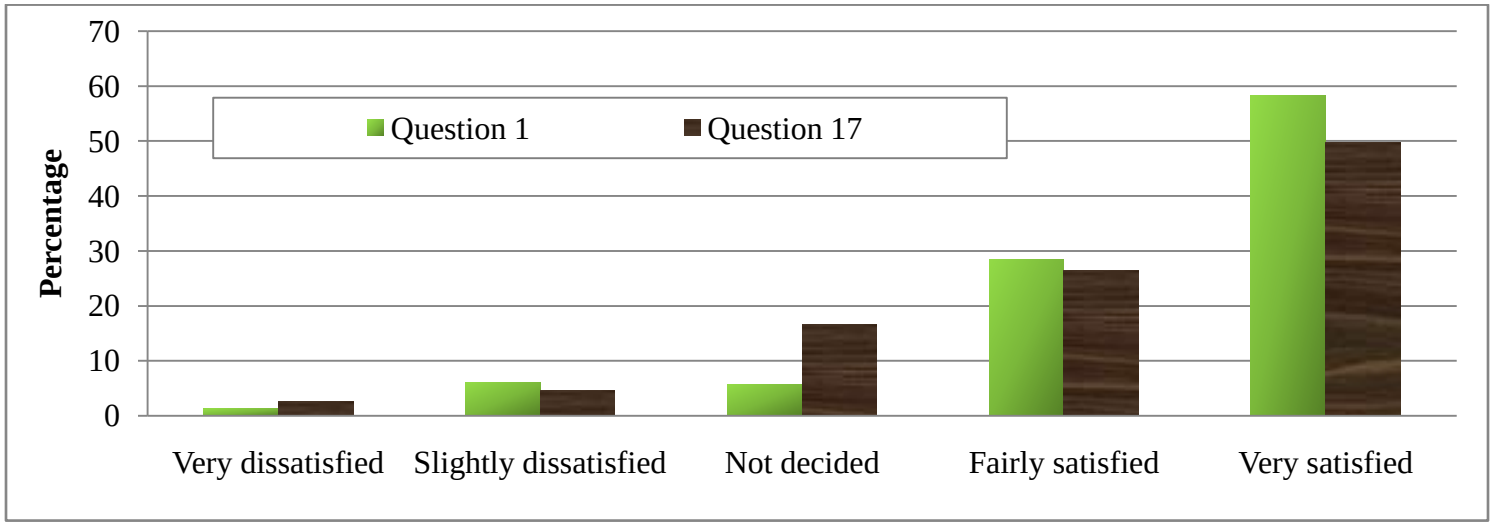


Figure 6.1 Responses to Survey Question 1 and Question 17

Table 6.2 Descriptive Statistics: Residents Satisfaction on Individual Factors

Survey item *	N	Mean	Median	St. dev.
Natural amenities				
view from house/apartment	158	3.65	4.00	1.12
quietness of the neighborhood	158	4.04	4.00	1.10
availability of nearby parks and green space	156	4.13	4.00	1.06
availability of nearby natural recreation opportunities (tubing, fishing, boating, etc.)	156	4.11	4.00	1.07
Social amenities				
travel distance from your home to school/day care	152	4.02	4.00	0.95
travel distance from your home to your/ your spouse's workplace	151	3.88	4.00	1.14
travel distance from your home to retail stores	157	4.33	4.00	0.78
travel distance from your home to health-care facilities	156	4.14	4.00	0.96
neighbors (Do you feel comfortable living near them?)	158	4.19	4.00	0.95
crime rate of your neighborhood	157	4.01	4.00	1.00
House features				
visual attractiveness of your house/apartment	157	3.73	4.00	1.10
price or rent you paid for your house/apartment	156	4.08	4.00	1.06
size of your house/apartment	155	4.00	4.00	1.03
Flood hazard				
potential for flood damage or losses caused by flooding	156	3.24	3.00	1.30
your capability to recover from flood losses	154	3.16	3.00	1.26
cost of flood insurance for your house or property?	148	2.99	3.00	1.18

*Scale ranges from" very dissatisfied" (1) to "very satisfied" (5).

Table 6.3 Rate the Importance of Home Location-related Characteristics

Survey item *	N	Mean	Median	St. dev.
Natural amenities		4.85		
Natural features	155	5.05	5	1.75
Outdoor recreation and natural beauties	155	4.65	5	2.13
Social amenities		5.14		
Close to friends, family, or other social relationships	156	4.96	5	1.82
Close to work, school, retail store, etc.	156	5.32	6	1.55
Hazard exposure		4.39		
Exposure to natural hazards	154	4.49	4	2.02
Hazard-related issues	154	4.29	4.5	2.03
House		5.39		
Characteristics of house	155	5.39	6	1.61

*Scale ranges from" not important" (1) to "extremely important" (7).

6.4 RELOCATION CHOICES

More than 30 percent of residents planned to move to another location in the near future (question 4), but only 21 percent of residents intended to relocate to a non-flood-prone area (question 9). The proportion of relocation to any other place is 25 to 38 percent and to non-flood-prone area is 16 to 27 percent. These data suggest that floodplain residents do not seriously consider flood-related issues in their home location decisions. Responses to questions 4 and 9 are significantly associated ($\chi^2 = 282.13$, $\alpha = 0.05$), but their association is weak ($C = 0.426$, $V = 0.392$).

A closer look at reasons for moving reveals that only one among 30 listed explanations is related to flood risk. The most frequent explanation given was "need more space." The second most cited reason was need to live "closer to workplace." This was followed by the desire to own a house and dissatisfaction with neighbors.

The answers to why not to relocate to a non-flood-prone area varied as well. Nearly one-third (26%) of respondents did not think that flooding was a problem. They said "(I live in a) flood zone but the chance of flooding is very small," "(I) don't think flooding will re-occur anytime soon," or "It does not flood that often." About 20 percent of respondents were attached to their places, claiming either they love to live close to river or love where they live. Financial difficulty accounted for 13 percent of explanations for being unwilling to move to a non-flood-prone area. Only seven percent of respondents said they were ready for the flood and did not need to relocate their houses. Explanations for willingness to relocate focused either on the negative impact of flooding on daily life, such as "… the street floods and I either cannot leave or cannot come home…" or "Flood insurance help with losses but some personal things cannot (be)

replaced." Others focused on unpleasant feelings caused by the flooding, such as, "… I don't have to worry about floods every time it rains" or "… to be more comfortable when flooding may occur."

6.5 PERCEPTIONS OF FLOOD RISK

Survey respondent were asked whether they were aware of the flood risk before they moved to their current home (question 6). More than half of respondents (51 percent) stated that they were aware of the flood risk before they moved, but justified their choice by giving reasons similar to those given to explain unwillingness to relocate to a non-flood-prone area: "the probability of flooding was very small" was the most frequently cited answer for why they moved to their current home (52 percent). Because most survey respondents (86 percent) were floodplain residents and they have lived in the area for a period of time, I doubt that cognitive adjustments have affected responses to this question.

Nearly one quarter of respondents moved to their current home because they thought that the benefits exceeded the threats from floods. This is consistent with previous studies (Burby and others 1999; Kates 1962). Benefit from hazardous-zone occupancy is always the main reason for development in these areas. With population growth and urbanization, the benefit of hazard-prone-area development is even greater (Frame 1998; Montz and Gruntfest 1986).

Ten percent of respondents selected "I had no other choice" as their reason for moving into their current home. The other two reasons for floodplain residence, "the potential losses caused by floods were acceptable" and "I was going to undertake actions

to reduce flood losses," were the least often selected options; they only accounted for 2.3 percent and 1.7 percent, respectively. This result was unexpected. Because Americans, in general, enjoy to "do it yourself," I expected that many respondents would select "I was going to undertake actions to reduce flood losses" as a reason to support their choice for moving into a floodplain dwelling. The identified reasons of non- protective actions is lack of necessary information, such as probability of flooding, potential consequences of flooding, effectiveness and cost of private precautionary actions (Grothmann and Reusswig 2006). Another possible explanation is that people may prefer not to think about to improve their nearby living environment. They may feel everything just perfect and need not to do anything else to disrupt the current situation. Or they may be unintended to live in their current house for a long-time and don't want to spend extra energy or monetary to it. These possible explanations need to be tested.

Results for question 20, which asks survey participants who should take a responsibility to protect peoples' home, homeowners or government agencies, show that both of them were expected to play a role (Table 6.4). This was somewhat expected. Government agencies are expected to take responsibility for building dams/reservoirs, for developing flood-zone management plans, for warning residents of imminent flooding, and for other tasks that cannot be fulfilled by individual homeowners. Homeowners, on the other hand, should protect their property and personal possessions by following flood-zone construction guidelines, by responding to emergencies, and by undertaking other risk-mitigating actions.

Although more than half of survey respondents were aware of their flood risk, only 40 percent of respondents were sure that they lived in a floodplain and nearly one-

Table 6.4 Responsibility to Protect People and Properties from Flooding

	Homeowners (N=157)	Gov. agencies (N=156)
	Case (%)	Case (%)
Strongly disagree	11 (7)	10 (6)
Disagree	11 (7)	13 (8)
No opinion	29 (19)	21 (13)
Agree	68 (43)	70 (45)
Strongly agree	38 (24)	42 (27)

third of them either didn't think that they lived in the floodplain or didn't know whether they were living in a floodplain or not. The truth, however, is that 86 percent of survey respondents were actually living within a 100-year floodplain (Table 6.5). This discrepancy suggests that about the one-third of those floodplain residents responding to this survey misunderstand the level of their flood risk.

The disagreement between the respondents' expressed home location (within floodplain or not) with their actual home location may be caused by unfamiliar with or misinterpretation of the terms "100-year floodplain" or "500-year floodplain." Some residents seemed confused when I mentioned the term "floodplain" as I invited them to participate in the survey. Many of them seemed to prefer using the term "flood-zone" to "floodplain." Clearly there is still a significant risk communication problem with the terms used to describe flood probability, as indicated by recent research (Bell and Tobin 2007).

Answers to question 7 indicate that only 27 percent of residents feel threatened by potential flooding because of the location of their home. The test of population proportion finds that at most 33 percent of studied population feels threatened by flooding.

In summary, fifty-eight percent of floodplain residents are aware of flood risk embedded within their home location. Most of them (67 percent), however, do not feel threatened by potential flooding. The possible explanations for this low threat perception include, but are not limited to, a belief of a small chance of flooding and a belief in significantly greater perceived benefits from their home location. Surprisingly, about one-third of respondents either do not know that they are living in a floodplain or don't

Table 6.5 A Comparison of Actual and Expressed Residential Location (N=159)

		Claimed location	Actual location
		Case (%)	Case (%)
Live in floodplain (N=159, total survey respondent)	Yes	63 (40)	136 (86)
	No	24 (15)	-
	Don't know	21 (13)	-
	No response	27 (17)	-
Living in 100 or 500-year floodplain (N = 63, claimed floodplain respondents)	100-year	35 (56)	42 (67)
	500-year	8 (13)	21 (33)
	Don't know	20 (32)	-

think that they are living in a floodplain. The poor understanding of floodplain residence may reduce the likelihood of undertaking flood-risk mitigation actions, following emergency messages, and cooperating with floodplain management efforts.

6.6 PREPARATIONS FOR FLOODING

Only 22 percent of respondents have undertaken actions to prevent damage from flooding (question 8), and less than 40 percent of respondents had flood insurance (question 12). An elderly lady told me, "I did not purchase flood insurance but I have fire insurance …" She knew that fire would destroy her house but is unaware that a flood could do it too. The lady lives in the 100-year floodplain. Her house is more likely to be damaged by water rather than a fire. The proportion of the floodplain residents who undertook flood protection is 28 percent, and who had purchased flood insurance is 46 percent. Acquiring flood insurance and raising the structures within the floodplain are two major options for preventing losses from flooding. Respondents who adopted these two options were 47 percent and 27 percent, respectively. Other actions includes "talked or wrote to city and county officials about the problem," "built dams around property," "smoothed drainage system."

6.7 FLOOD EXPERIENCES

Since the studied populations were floodplain residents, I expected that many survey respondents' home had been flooded since they moved into the study area. However, only 16 percent of respondents have experienced a flood at their current location. Based on this sample data, at most 21 percent of studied floodplain

population's home have been flooded. One possible explanation for this unexpected finding is that many survey respondents moved to study area only recently[8]. Another is that elevated houses kept them out of floodwaters. Many houses in the studied floodplain have been raised (Figures 6.2a & 6.2b). One respondent said that his/her house had been raised three times. Another one rebuilt his home on pilings after the 1998 flood. This elevated his home about 3 feet above the ground. Nearly half of respondents have experienced flooding in the streets or yards surrounding their residents. For the entire study population, at most 54 percent of them have experienced flooding near their houses.

6.8 ESTIMATED FLOOD PROBABILITY

Survey respondents have been asked to estimate the potential for flooding of their home, areas near their home (10 feet away from respondent's house), surrounding neighborhood, and City of San Marcos. Survey results indicate that respondents rate the flood-risk of their homes (probability that it will be flooded within the next year) to be the lowest among food-risk to all of the other examined areas (Table 6.6 and Figure 6.3). This finding is consistent with previous studies, which documented that people frequently claim themselves to be less subject to risk than others (Pronin, Lin, and Ross 2002; Sjoberg 2000; Correia and others 1998; Friedrich 1996). Confidence in their flood preparation actions or in the effectiveness of other flood protection structures, belief in a very low probability of heavy rain, and other issues including cognitive adjustments may

[8] The total population in San Marcos is 34,733 in 2000 and 47,181 in 2006 (US Census 2006, http://www.census.gov/ Accessed online January 23, 2008).

Figure 6.2a Raised Houses in Floodplain

Figure 6.2b Raised Houses in Floodplain

Table 6.6 Estimated Flood Probabilities from Respondents

	Low	Moderate	High	Very high	Extreme	Don't know
	Case (%)	Case (%)	Case (%)	Case (%)	Case (%)	Case (%)
Your home (N=151)	68(45)	30 (20)	6(4)	5(3)	2(1)	40(26)
Near your home(N=152)	45(30)	48(32)	7(5)	8(5)	7(5)	37(24)
Your neighborhood (N=152)	45(30)	42(28)	11(7)	9(6)	5(3)	40(26)
San Marcos (N=153)	16(10)	54(35)	24(16)	12(8)	7(5)	40(26)

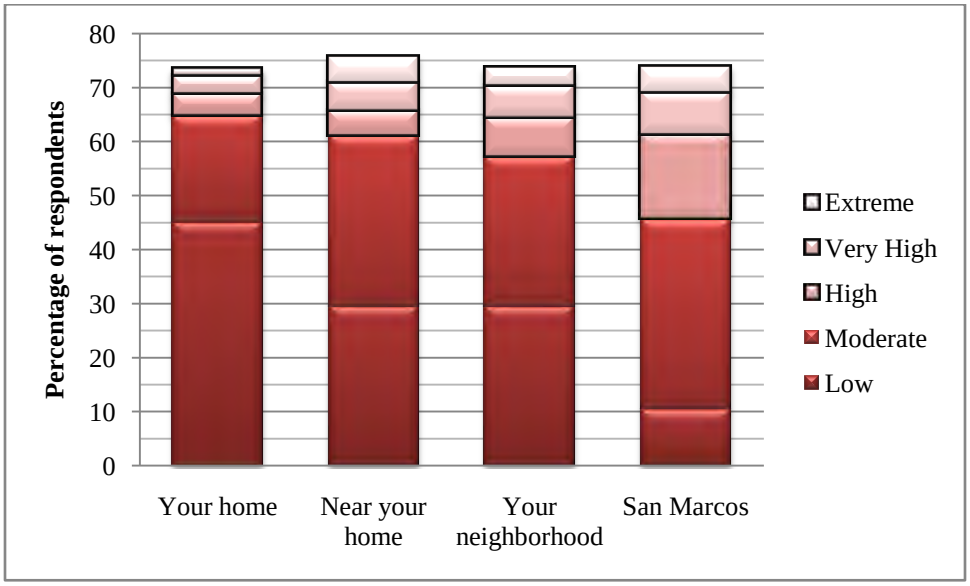


Figure 6.3 Estimated Flood Probabilities from Respondents

contribute to their lowered estimates of flood probability. Unfortunately, there is no way to determine why respondents rate their home at the lowest flood-risk.

6.9 A HIGHER RISK OR LOCATION-RELATED AMENITIES

About one-third of respondents selected "Yes" to question 18, which asked whether survey respondents were willing to accept a higher risk in order to be closer to natural amenities. Twenty-three percent of respondent selected "Yes" to question 19, which asks whether respondents are willing to accept a higher risk in order to be closer to social amenities. These answers show that more people would be willing to accept a higher chance of flooding to live closer to water-related natural amenities than to social amenities. Living closer to a river provides many chances for easy access to water-related natural amenities, many of which are irreplaceable or "un-substitutable," these include aesthetic views, outdoor recreation opportunities (fishing, river-side walking, swimming, boating, etc.), and other intangible but perceptual pleasures. Many home location-related social amenities, on the other hand, are replaceable, things such as access to retail stores or a highway and proximity to schools or health facilities. But some of them are difficult to replace, such as friendly neighbors or relatives. So, it is understandable that many people willing to accept a higher chance of risk in order to be closer to social amenities.

6.10 SUMMARY

I end this chapter by listing the findings from the study:

- Most floodplain residents were satisfied with their residential location. More than 75 percent of survey participants claimed that they were satisfied with their current home location.
- The characteristics that were most related to residential preferences, in order of importance, were housing characteristics, social amenities, natural amenities, and hazards characteristics.
- About one-third of floodplain residents planned to relocate but only one-fifth of them intended to relocate to a non-flood-prone area. This may suggest that about 20 percent of floodplain dweller in the San Marcos floodplain were bothered by location-related flood problems.
- Only 51 percent of study participants were aware of flood risk before they moved into their current houses, and only 40 percent of respondents know that they are living in a floodplain.
- The perception of low flood probability was the dominant explanation for living in the floodplain, and was followed by the perception that location-related benefits exceeded the threats from floods and that there was no other choice.
- Only 28 percent of the entire study population undertook protective actions to prevent damages from flooding and less than half of them (46%) purchased flood insurance.
- Although all respondents are floodplain residents, only less than 20 percent of them have experienced a flood at their current home location. Flood control dams and

elevated floor may contribute to this. Another possible explanation is that some floodplain residents are newcomers. They have not encountered floods.

- Survey respondents rated the flood-risk of their homes as the lowest among the other examined areas. This finding is consistent with previous studies.
- More respondents are willing to accept a higher chance of risk in order to be closer to location-embedded natural amenities than social amenities.

CHAPTER 7

ANALYSIS OF SURVEY RESULTS

This chapter presents the results of statistical analyses focusing on the influences of flood risk awareness on residential satisfaction and willingness to accept higher risk for location-related benefits. Additionally, this chapter provides an interpretation of estimated coefficients produced by ordinal regressions showing the contribution of each category of each variable to residents' satisfaction with their home locations. The role of each variable in predication of residents' willingness to accept a higher chance of risk for desired location-related benefits is presented as well.

7.1 AWARENESS OF FLOOD RISK

Responses from survey respondents indicate that more than half of respondents (51 percent) are aware of location-embedded flood risk. According to proportion test, about 58 percent of the entire floodplain residents are aware of flood problems. This section presents the influence of flood-risk awareness on residential satisfaction and acceptance of higher flood risk in exchange for either natural or social amenities.

7.1.1 Risk Awareness and Residential Satisfaction

Comparing residential satisfaction rated by residents who were aware of flood risk with residents who were unaware of it, it is clear that residents who were aware of location-related flood risk are more satisfied with their home locations than those who were unaware of the risk (Figure 7.1a and Figure 7.1b). The distances between these two groups (residents who were aware of flood risk and residents who were unaware of flood risk) in each category are larger in latter group than in the former. This indicates that the difference of perceived residential satisfaction between these two groups was amplified if location-related hazards characteristics were considered in the process of rating residential satisfaction.

7.1.2 Risk Awareness and Satisfaction with Location-related Characteristics

The effects of flood-risk awareness on location-related characteristics are measured by the Mann-Whitney U-test. Respondents have been grouped into two groups: one contains respondents who were aware of location-related flood risk and the other includes those who were unaware of the risk. Four null hypotheses to be tested are: residents who were aware of flood risk are equal or less satisfied with location-related (a) natural and (b) social amenities, (c) hazard characteristics, and (d) housing characteristics when being compared to those who were unaware of flood risk. The alternative hypotheses to be tested are: residents who were aware of flood risk are more satisfied with location-related (a) natural and (b) social amenities, (c) hazard characteristics, and (d) housing characteristics.

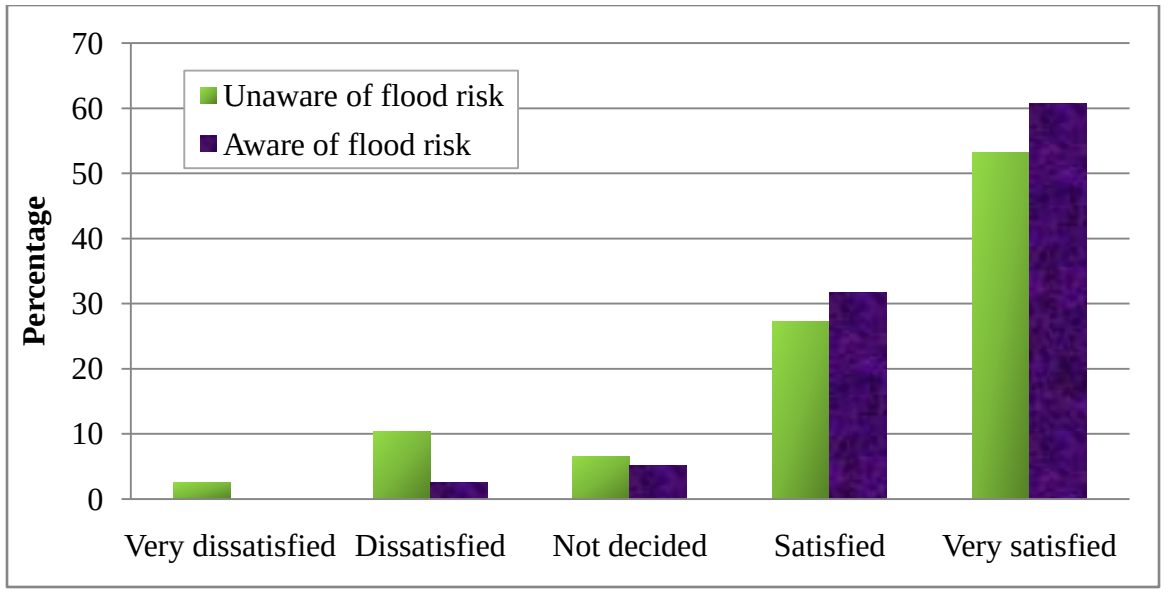


Figure 7.1a Influence of Risk Awareness on Residential Satisfaction (Q1)

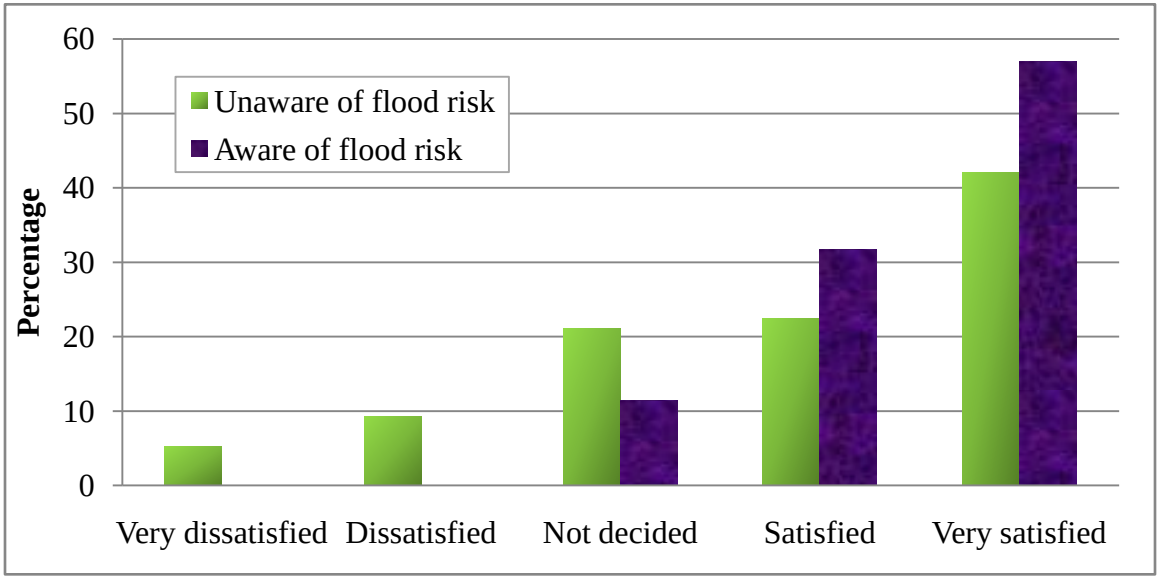


Figure 7.1b Influence of Risk Awareness on Residential Satisfaction (Q17)

Residents' satisfaction with location-related characteristics has been measured by different survey items (specifically questions 3 and 5). The internal consistency of these location-related items, being acceptable (Table 7.1), allows one to build indices to represent location-embedded features. The results of the Mann-Whitney U-tests indicate that all null hypotheses are true except for the hypothesis that addresses location-related natural amenities (Table 7.2). These results indicate that residents who were aware of flood risk are more satisfied with location-related natural amenities and are less or equally satisfied with location-related social amenities, hazards characteristics, and their houses. This is reasonable considering the irreplaceable nature of water-based natural amenities.

7.1.3 Acceptance of Higher Risk for Location-related Amenities

Compared to the more than one-third of residents (32 percent) who were aware of flood risk and were willing to accept a higher flood risk in exchange for location-related social amenities, only 17 percent of residents who were unaware of their flood risk would be willing to accept a higher risk for the same location-related amenities (Table 7.3). Similarly, residents who were aware of flood risk were more likely to accept a higher risk for location-related natural amenities than those who were unaware of flood risk: 42 percent of flood-risk aware residents were willing to accept a higher risk for location-related natural amenities, while only 22 percent of flood-risk unaware residents were willing to accept a higher risk in exchange for natural amenities (Table 7.3). Put another way, residents who were aware of flood risk are more likely to accept a higher flood risk

Table 7.1 Internal Consistency of Location-related Characteristics

	Natural amenities	Social amenities	Hazard characteristics	House characteristics
Q3	0.685	0.703	0.840	0.648
Q5	0.768	0.536	0.882	-

Table 7.2 Results of Mann-Whitney U-test

	Natural amenities	Social amenities	Hazard related issues	House characteristics
Q3	-3.186*	-0.259	-0.019	-0.619
Q5	-2.086*	-1.530*	-0.379	-1.085
*Significant at $\alpha = 0.05$.				

Table 7.3 Risk Awareness vs. Acceptance of a Higher Risk
for Desired Location-related Amenities (N=145)

			Q18*		Q19**	
			No	Yes	No	Yes
Awareness of flood risk (Q6)	No	Count	54	15	57	12
		% within Risk Awareness	78.3	21.7	82.6	17.4
	Yes	Count	44	32	52	24
		% within Risk Awareness	57.9	42.1	68.4	31.6

*Q18: acceptance of a higher risk for location-related natural amenities. Pearson Chi-Square = 6.85, Cramer's V = 0.22 and Contingency Coef. = 0.21. Sig. at α =0.05.
** Q19: acceptance of a higher risk for location-related social amenities. Pearson Chi-Square = 3.90, Cramer's V = 0.16 and Contingency Coef. = 0.16. Sig. at α = 0.05.

in order to be closer to natural or social amenities. Risk awareness and high risk acceptance for location-related amenities are related to a statistically significant degree, but the association is weak (Table 7.3).

7.2 PREDICTORS OF RESIDENTIAL SATISFACTION

Ordinal regressions have been used to identify factors that may predict residents' residential satisfaction. The dependent variables (DVs) in the regressions are residents' expressed residential satisfaction (ERS) levels obtained from survey questions 1 and 17. The independent variables (IVs) include location-related characteristics (natural amenities, social amenities, and hazard characteristics) and social-demographic factors. Because the cumulative probabilities of ERS increases from 0 fairly slowly and then rapidly approach to 1 (Figure 7.2), the complementary log-log link function was applied first. The logit link function was used to redo the regressions to see if a better model could be constructed. The efficiencies of models from different link functions are determined by comparing model-fitting information. The validation of models is examined by construction confusion matrixes which cross-tabulate the predicted residential satisfaction (PRL) with the expressed residential satisfaction (ERS) and show how often the models can produce correct predicted residential satisfaction (PRL).

7.2.1 Results of Ordinal Regressions (DV: Question 1)

Four ordinal regression models were constructed to highlight the role of each individual variable (Tables 7.4 and 7.5). The IVs in model one are four location-related characteristics constructed using data collected from survey question 3. Model two

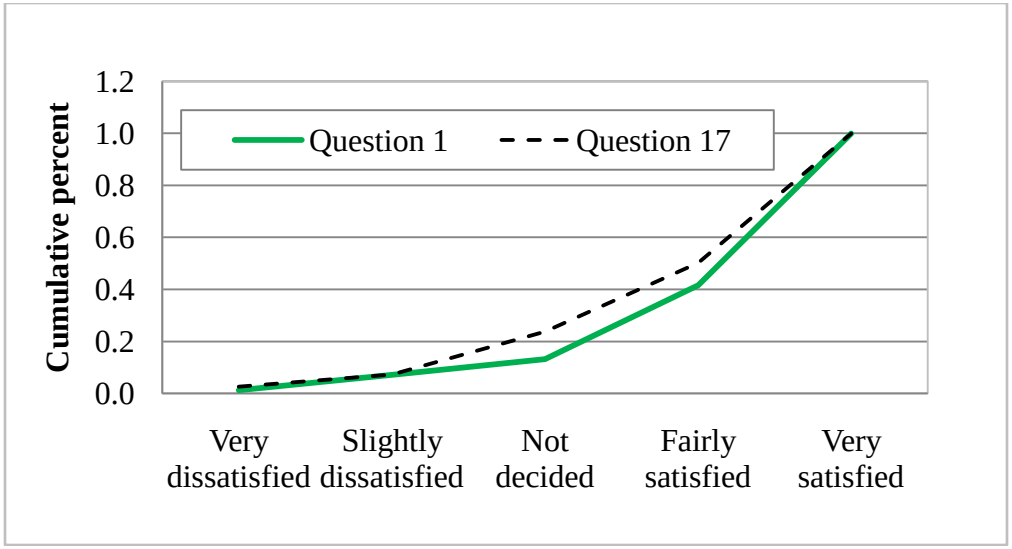


Figure 7.2 The Cumulative Probability of Expressed Residential Satisfaction (ERS)

Table 7.4 Results of Ordinal Regressions-1
(DV: ERS from Q1; Link function: Complementary log-log)

Independent Variables		Model 1	Model 2	Model 3	Model 4
Location-related Characteristics					
Natural Amenities	Very dissatisfied	-4.326*		-	-0.248
	Dissatisfied	-1.015		-0.964	-0.541
	Un-decided	-1.845*		-1.994*	-1.840*
	Satisfied	-0.489		-0.336	-0.593
	Very satisfied	0(a)		0(a)	0(a)
Social Amenities	Very dissatisfied	-		-	
	Dissatisfied	1.403		2.732	
	Un-decided	-0.362		-0.904	
	Satisfied	-0.356		-0.547	
	Very satisfied	0(a)		0(a)	
Hazards characteristics	Very dissatisfied	-0.461		-0.595	
	Dissatisfied	0.4990		1.056	
	Un-decided	0.378		0.423	
	Satisfied	0.691		1.055	
	Very satisfied	0(a)		0(a)	
Housing characteristics	Very dissatisfied	-5.479*		-4.766*	-1.793
	Dissatisfied	-2.597*		-3.255*	-2.937*
	Un-decided	-1.510*		-1.448*	-1.516*
	Satisfied	-0.894*		-1.024*	-0.963*
	Very satisfied	0(a)		0(a)	0(a)
Social-economic factors					
Age			-0.006	-0.010	
Education			-0.056	-0.007	
Sex	Female		0.177	-0.197	
	Male		0(a)	0(a)	
Kids	None		0.397	0.573	
	One		0.392	0.448	
	Two		0.227	0.885	
	Three		0.310	0.331	
	More than three		0(a)	0(a)	
Pets	None		-0.712	-0.750	-0.674
	One		-0.681	-1.006	-0.851
	Two		-1.168*	-1.478*	-1.038*
	Three		-0.869	-0.459	-0.652
	More than three		0(a)	0(a)	0(a)
Ownership of house	No		-0.026	0.157	
	Yes		0(a)	0(a)	

Table 7.4 – Continued					
		Model 1	Model 2	Model 3	Model 4
Accommodation type	Single family home		0.614	0.957	
	Mobile home		-0.155	0.894	
	Apartment		-0.364	-0.304	
	Other		0(a)	0(a)	
Occupation	Employed		-0.884	-0.996	
	Part-time		-0.716	-1.219	
	Unemployed		-0.916	-1.297	
	Retired		0.392	0.150	
	Student		-0.068	0.155	
	Others		0(a)	0(a)	
Test of parallel lines	*p*	0.748	0.782	0.999	0.996
Goodness-of-Fit	*p*	0.998	0.836	1.000	0.994
*Significant at $\alpha = 0.05$. a: The reference category.					

Table 7.5 Results of Ordinal Regressions-2
(DV: ERS from Q1; Link function: Logit)

Variables		Model 1	Model 2	Model 3	Model 4
Location-related Characteristics					
Natural Amenities	Very dissatisfied	-5.113*		-	-1.157
	Dissatisfied	-1.158		-0.679	-0.640
	Un-decided	-2.440*		-2.448*	-2.484*
	Satisfied	-0.616		-0.525	-0.728
	Very satisfied	0(a)		0(a)	0(a)
Social Amenities	Very dissatisfied	-		-	
	Dissatisfied	1.702		3.843	
	Un-decided	-0.675		-1.436	
	Satisfied	-0.425		-0.634	
	Very satisfied	0(a)		0(a)	
Hazards characteristics	Very dissatisfied	-0.465		-0.479	
	Dissatisfied	0.577		1.235	
	Un-decided	0.598		0.603	
	Satisfied	0.765		1.182	
	Very satisfied	0(a)		0(a)	
Housing characteristics	Very dissatisfied	-23.336		-22.211	-2.731
	Dissatisfied	-3.059*		-4.702*	-3.601*
	Un-decided	-1.923*		-2.359*	-2.077*
	Satisfied	-1.062*		-1.486*	-1.269*
	Very satisfied	0(a)		0(a)	0(a)
Social-economic factors					
Age			-0.003	-0.006	
Education			-0.048	-0.007	
Sex	Female		0.236	-0.437	
	Male		0(a)	0(a)	
Kids	None		0.300	0.432	
	One		0.270	0.150	
	Two		0.133	1.075	
	Three		0.288	0.641	
	More than three		0(a)	0(a)	
Pets	None		-0.993	-1.180	-0.986
	One		-1.001	-1.621*	-1.260*
	Two		-1.482*	-2.327*	-1.479*
	Three		-1.134	-1.103	-1.127
	More than three		0(a)	0(a)	0(a)

Table 7.5 – Continued					
		Model 1	Model 2	Model 3	Model 4
Accommodation type	Single family home		0.998	1.463	
	Mobile home		0.217	1.557	
	Apartment		0.500	0.197	
	Other		0(a)	0(a)	
Ownership of house	No		0.007	0.189	
	Yes		0(a)	0(a)	
Occupation	Employed		-1.207	-1.247	
	Part-time		-0.875	-1.253	
	Unemployed		-1.535	-1.512	
	Retired		0.336	0.035	
	Student		-0.254	0.497	
	Others		0(a)	0(a)	
Test of parallel lines	*p*	0.929	0.599	0.340	0.766
Goodness-of-Fit	*p*	1.000	0.951	1.000	1.000
*Significant at $\alpha = 0.05$. a: The reference category.					

measures the role of social-demographic factors. Model three examines location-related characteristics and social-demographic factors. Model four investigates variables that are statistically significant related to the DV, the expressed residential satisfaction (ERS), based on the results of the first three models.

Estimated coefficients from ordinal regression

Before examining individual coefficients, I will first look at the Goodness-of-fit information and the testing of parallel lines. The results of these two tests had large observed significance levels that indicated the model-fit statistic and the regression coefficients were the same for all categories of the outcome variable (Table 7.4 and Table 7.5).

The results of ordinal regressions show that social amenities and hazards-related issues are not related to the expressed residential satisfaction (ERS) levels, while natural amenities and house characteristics are statistically related to the ERS (Tables 7.4 and 7.5 Models 1, 3, and 4). Compared to residents who are very satisfied with their home location-related natural amenities and housing characteristics, residents who are less satisfied with those two features are less likely to assign a higher level of satisfaction with their home location.

Pet ownership is the only factor that is statistically related to ERS among the measured eight social-demographic factors. The more pets that a household owns, the more likely they are to be satisfied with their home location (Tables 7.4 and 7.5 Models 2, 3, and 4). Age and education hold negative coefficients relative to ERS, indicating that the probability of being in one of the higher residential satisfaction categories decreases

with increasing age or education level (Tables 7.4 and 7.5 Models 2 and 3). Retired residents are more likely to be satisfied with their home than their counterparts (Tables 7.4 and 7.5 Models 2 and 3). Comparing coefficient of sex in models two and three (Table 7.4 and 7.5), females are more likely to assign a higher satisfaction of their location than are males in model 2; but female are less likely to be satisfied with their home location than are males in model 3 (Tables 7.4 and 7.5 Models 2 and 3). This suggests that women are more sensitive to location-embedded amenities, hazards, and house characteristics than are men.

Models using complementary log-log link function find that renters are less likely to be satisfied with their residences than home owners when only taking social-demographic factors into consideration; while consideration of location-related characteristics changes renters' residential satisfaction from less likely to more likely to be satisfied (Tables 7.4 Models 2 and 3). The results of models using logit link function indicate that assigned residential satisfaction is no difference between homeowners and renters, but once location-related characteristics are taken into consideration, renters are more likely to be satisfied with their location (Tables 7.5 Models 2 and 3). The role of accommodation type on residential satisfaction is different between the two link functions. "Single-family home" is the only coefficient with a positive sign in models based on complementary log-log link function, while it is one of three positive coefficients in models based on logit link function.

Model Validation

The predicted residential satisfaction is statistically associated with the level of satisfaction expressed (Table 7.6 and Table 7.7). The values of Kendall's tau-b and Kendall's tau-c indicate that the strengths of the associations are not strong (i.e. the value range of Kendall's tau-b is 0.245-0.553 and the value range of Kendall's tau-c is 0.215-0.383). The classification table (Table 7.6) shows that the category, *very satisfied*, was predicated most successfully by the models. Of the 88 people who selected the response *very satisfied*, 80 (91%) are correctly predicted by the first model. The percentages of those correctly predicted by the second, third and fourth models are 89, 88, and 87, respectively. Models two and four better predict the category *satisfied* than models one and three. None of the respondents who selected *un-decided* (neither satisfied nor dissatisfied) are correctly assigned. Two dissatisfied categories, *very dissatisfied* and *dissatisfied*, are poorly predicted. Correct classification rates based on the models with logit link function show similar results (Table 7.7). The dissatisfied categories are under-predicted and the satisfied categories are better predicted. The category *neither satisfied nor dissatisfied* is never predicted properly by any of the models.

Both classification tables show that the cases in category *satisfied* are more likely to be classified as *very satisfied*. The two satisfied categories were merged to improve the prediction. The two categories expressing dissatisfaction were also merged as they were poorly predicted as separate categories. To distinguish the differences between having children or pets and not having children or pets, categories based on the numbers of kids and pets were also merged into two collective categories: *none* and *yes*. The results of regressions using merged categories indicate that the percentages of correct

Table 7.6 Model Validation-1
(Models with Complementary Log-log Link Function)

		Residents expressed residential satisfaction (ERS) (Q1)										Total	
		Very dissat.		Dissatisfied		Un-decided		Satisfied		Very satisfied			
		Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)
Model 1 predicated residential satisfaction (PRS)[1]	Very dissatisfied	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
	Dissatisfied	0	0.0	1	10.0	2	22.2	0	0.0	0	0.0	3	1.9
	Satisfied	1	50.0	7	70.0	5	55.6	22	47.8	8	9.1	43	27.7
	Very sa.	0	0.0	2	20.0	2	22.2	24	52.2	80	90.9	108	69.7
Model 2 PRS[2]	Satisfied	1	50.0	3	33.3	0	0.0	18	40.0	9	10.8	31	21.2
	Very sat.	1	50.0	6	66.7	7	100.0	27	60.0	74	89.2	115	78.8
Model 3 PRS[3]	Very dissat.	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7
	Dissatisfied	1	50.0	3	33.3	2	28.6	0	0.0	0	0.0	6	4.1
	Satisfied	0	0.0	5	55.6	2	28.6	23	51.1	10	12.2	40	27.6
	Very sat.	0	0.0	1	11.1	3	42.9	22	48.9	72	87.8	98	67.6
Model 4 PRS[4]	Dissatisfied	0	0.0	1	10.0	1	12.5	0	0.0	0	0.0	2	1.3
	Satisfied	2	100.0	6	60.0	6	75.0	19	41.3	12	13.5	45	29.0
	Very sat.	0	0.0	3	30.0	1	12.5	27	58.7	77	86.5	108	69.7

*Percentage of predicated residential satisfaction within the expressed satisfaction.
[1]Kendall's tau-b = 0.553, Kendall's tau-c = 0.372, all significant at $\alpha = 0.05$.
[2]Kendall's tau-b = 0.245, Kendall's tau-c = 0.215, all significant at $\alpha = 0.05$.
[3]Kendall's tau-b = 0.531, Kendall's tau-c = 0.367, all significant at $\alpha = 0.05$.
[4]Kendall's tau-b = 0.457, Kendall's tau-c = 0.341, all significant at $\alpha = 0.05$.

Table 7.7 Model Validation-2
(Models with Logit Link Function)

		Residents expressed residential satisfaction (Q1)										Total	
		Very dissat.		Dissatisfied		Un-decided		Satisfied		Very satisfied			
		Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)
Model 1 predicated residential satisfaction (PRS)[1]	Very dissatisfied	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
	Dissatisfied	0	0.0	1	10.0	2	22.2	0	0.0	0	0.0	3	1.9
	Satisfied	1	50.0	7	70.0	5	55.6	21	45.7	11	12.5	45	29.0
	Very sat.	0	0.0	2	20.0	2	22.2	25	54.3	77	87.5	106	68.4
Model 2 PRS[2]	Satisfied	1	50.0	3	33.3	0	0.0	17	37.8	8	9.6	29	19.9
	Very sat.	1	50.0	6	66.7	7	100.0	28	62.2	75	90.4	117	80.1
Model 3 PRS[3]	Very dissat.	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7
	Dissatisfy	1	50.0	3	33.3	2	28.6	1	2.2	0	0.0	7	4.8
	Satisfied	0	0.0	5	55.6	4	57.1	22	48.9	12	14.6	43	29.7
	Very sat.	0	0.0	1	11.1	1	14.3	22	48.9	70	85.4	94	64.8
Model 4 PRS[4]	Dissatisfied	2	100.0	2	20.0	1	12.5	1	2.2	0	0.0	6	3.9
	Satisfied	0	0.0	6	60.0	6	75.0	19	41.3	13	14.6	44	28.4
	Very sat.	0	0.0	2	20.0	1	12.5	26	56.5	76	85.4	105	67.7

*Percentage of predicated residential satisfaction within the expressed satisfaction.
[1]Kendall's tau-b = 0.504, Kendall's tau-c = 0.343, all significant at $\alpha = 0.05$.
[2]Kendall's tau-b = 0.251, Kendall's tau-c = 0.215, all significant at $\alpha = 0.05$.
[3]Kendall's tau-b = 0.541, Kendall's tau-c = 0.383, all significant at $\alpha = 0.05$.
[4]Kendall's tau-b = 0.487, Kendall's tau-c = 0.376, all significant at $\alpha = 0.05$.

prediction of both *satisfied and dissatisfied* were improved (Table 7.8); while the model-fitting information and the test of parallel lines suggest that the models were no better than the former models (Table 7.9). The models with merged categories highlight the differences between residents with pets and children and those without. Residents without pets or children are less likely to rate a higher satisfaction of their location than those who have them (Table 7.9).

Efficiency of link function

Comparing the values of the model-fitting information, the pseudo r-square, and the percentage of correct prediction of very satisfied, I find that the complementary log-log models have higher values than logit models, in general (Table 7.10). This suggests that the complementary log-log models are more effective than the logit models. Therefore, the complementary log-log link function models should be used to predicate residential satisfaction.

7.2.2 Results of Ordinal Regressions (DV: Question 17)

Five ordinal regression models were constructed to highlight the role of each individual variable (Tables 7.11 and 7.12). The IVs in model one are four factors that deal with flood-related issues. Model two evaluates contributions of location-related characteristics. Model three investigates the role of social-demographic factors. Model four includes all variables appearing in the first three models. Model five measures variables that are statistically significant with the DV, the expressed residential satisfaction (ERS), based on the results of the first four models.

Table 7.8 Model Validation-3
(Models with Merged Category)

		ERS-Q1						Total	
		Dissatisfied		Un-decided		Satisfied			
		count	(%*)	count	(%*)	count	(%*)	count	(%*)
PRS[1] (Complementary log-logy):	Dissatisfied	5	45.5	2	28.6	2	1.6	9	6.2
	Satisfied	6	54.5	5	71.4	125	98.4	136	93.8
PRS[2](Logit):	Dissatisfied	5	45.5	2	28.6	1	0.8	8	5.5
	Satisfied	6	54.5	5	71.4	126	99.2	137	94.5

*Percentage of predicated residential satisfaction within the expressed satisfaction.
[1]Kendall's tau-b = 0.509, Kendall's tau-c = 0.165, all significant at $\alpha = 0.006$.
[2]Kendall's tau-b = 0.549, Kendall's tau-c = 0.168, all significant at $\alpha = 0.005$.

Table 7.9 Results of Ordinal Regressions-3
(DV: ERS from Q1, IV: Using merged category)

Variables		Model (Complementary log-log)	Model (Logit)
Location-related Characteristics			
Natural Amenities	Very dissatisfied	-	-
	Dissatisfied	0.469	0.753
	Un-decided	-1.037	-1.570
	Satisfied	0.388	0.665
	Very satisfied	0(a)	0(a)
Social Amenities	Very dissatisfied	-	-
	Dissatisfied	5.457	15.478
	Un-decided	-1.118	-2.156
	Satisfied	0.584	0.135
	Very satisfied	0(a)	0(a)
Hazards characteristics	Very dissatisfied	-1.780	1.541
	Dissatisfied	-0.161	1.356
	Un-decided	0.366	1.055
	Satisfied	0.388	2.156
	Very satisfied	0(a)	0(a)
Housing characteristics	Very dissatisfied	-3.720	-33.595
	Dissatisfied	-2.657*	-16.658
	Un-decided	-2.751*	-14.640
	Satisfied	-1.669	-13.287
	Very satisfied	0(a)	0(a)
Social-economic factors			
Age		0.018	-0.031
Education		0.184	0.313
Sex	Female	-0.510	-0.597
	Male	0(a)	0(a)
Kids	None	-0.448	-0.408
	Yes	0(a)	0(a)
Pets	None	-0.567	-0.269
	Yes	0(a)	0(a)
Ownership of house	No	0.699	0.362
	Yes	0(a)	0(a)
Accommodation type	Single family home	1.281	2.491
	Mobile home	1.348	3.656
	Apartment	1.022	2.183
	Other	0(a)	0(a)

Table 7.9 – Continued			
		Model (Complementary log-log)	Model (Logit)
Occupation	Employed	-2.354	-14.719
	Part-time	-1.902	-14.338
	Unemployed	-1.921	-14.077
	Retired	-0.731	0.080
	Student	-3.487	-15.273
	Others	0(a)	0(a)
Test of parallel lines	*P*	0.006	0.329
Goodness-of-Fit	*P*	1.000	1.000
*Significant at $\alpha = 0.05$. a: The reference category.			

Table 7.10 Efficiency of Link Functions-1

Complementary log-log				Logit			
Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Model fitting information: Value of Chi-Square							
82.808*	23.831	97.814*	60.391*	74.061*	23.381	91.438*	62.460*
Pseudo R-Square: value of Cox and Snell							
0.414	0.151	0.491	0.323	0.380	0.148	0.468	0.332
Test of parallel lines: significance level							
0.748	0.782	0.999	0.996	0.929	0.599	0.340	0.766
Percentage of correct predication on category *very satisfy*							
69.7	78.8	67.6	69.7	68.4	80.1	64.8	67.7
*Significant at $\alpha = 0.05$.							

Table 7.11 Results of Ordinal Regressions-4
(DV: ERS from Q17; Link function: Complementary log-log)

Variables		Model 1	Model 2	Model 3	Model 4	Model 5
Threatened by floods	No	0.608*			0.365	0.614*
	Yes	0(a)			0(a)	0(a)
Undertaken actions	No	-0.129			0.107	
	Yes	0(a)			0(a)	
Relocation intention	No	1.016*			1.096*	0.569*
	Yes	0(a)			0(a)	0(a)
Flooded home	No	0.209			0.287	
	Yes	0(a)			0(a)	
Location-related Characteristics						
Natural Amenities	Very dissatisfied		-1.943			0.950
	Dissatisfied		-1.207		-0.658	-0.071
	Un-decided		-1.122*		-0.747	-0.973*
	Satisfied		-0.307		-0.341	-0.325
	Very satisfied		0(a)		0(a)	0(a)
Social Amenities	Very dissatisfied		-			
	Dissatisfied		-0.448		-1.172	
	Un-decided		-0.245		-0.694	
	Satisfied		-0.275		-0.430	
	Very satisfied		0(a)		0(a)	
Hazards characteristics	Very dissatisfied		-1.128		-0.972	
	Dissatisfied		-0.169		0.270	
	Un-decided		-0.230		-0.008	
	Satisfied		0.151		0.491	
	Very satisfied		0(a)		0(a)	
Housing characteristics	Very dissatisfied		-4.271*		-5.629	-2.256*
	Dissatisfied		-2.542*		-3.467*	-3.000*
	Un-decided		-1.683*		-2.599*	-1.518*
	Satisfied		-0.764		-1.297*	-0.791*
	Very satisfied		0(a)		0(a)	0(a)
Social-economic factors						
Age				-0.001	-0.029	
Education				-0.005	0.009	
Sex	Female			-0.010	-0.632	
	Male			0(a)	0(a)	

Table 7.11 – Continued						
		Model 1	Model 2	Model 3	Model 4	Model 5
Kids	None			-0.219	-0.338	
	One			-0.101	-0.332	
	Two			-0.129	-0.129	
	Three			-0.230	-0.626	
	More than three			0(a)	0(a)	
Pets	None			-1.009*	-1.075*	-0.787*
	One			-0.402	-0.287	-0.410
	Two			-0.406	-0.924	-0.462
	Three			-0.545	0.128	-0.392
	More than three			0(a)	0(a)	0(a)
Ownership of house	No			0.256	0.454	
	Yes			0(a)	0(a)	
Accommodation type	Single family home			0.695	1.099	
	Mobile home			0.640	2.388*	
	Apartment			0.578	1.114	
	Other			0(a)	0(a)	
Occupation	Employed			-0.665	-0.678	
	Part-time			0.115	0.472	
	Unemployed			-0.857	-2.896*	
	Retired			0.254	0.260	
	Student			-0.289	-0.631	
	Others			0(a)	0(a)	
Test of parallel lines	*p*	0.003	0.015	0.574	1.000	0.021
Goodness-of-Fit	*p*	0.032	0.342	0.787	0.906	0.319
*Significant at $\alpha = 0.05$. a: The reference category.						

Table 7.12 Results of Ordinal Regressions-5
(DV: ERS from Q17; Link function: Logit)

Variables		Model 1	Model 2	Model 3	Model 4	Model 5
Threatened by floods	No	0.932*			0.450	0.848*
	Yes	0(a)			0(a)	0(a)
Undertaken actions	No	-0.136			0.147	
	Yes	0(a)			0(a)	
Relocation intention	No	1.652*			1.517*	0.989*
	Yes	0(a)			0(a)	0(a)
Flooded home	No	0.729			0.851	
	Yes	0(a)			0(a)	
Location-related Characteristics						
Natural Amenities	Very dissatisfied		-2.362		-	
	Dissatisfied		-1.630		-0.002	0.850
	Un-decided		-1.467*		-1.084	-0.146
	Satisfied		-0.550		-0.413	-1.193*
	Very satisfied		0(a)		0(a)	-0.553
Social Amenities	Very dissatisfied		-		-	0(a)
	Dissatisfied		-0.285		-1.928	
	Un-decided		-0.791		-1.354	
	Satisfied		-0.471		-0.640	
	Very satisfied		0(a)		0(a)	
Hazards Characteristics	Very dissatisfied		-1.257		-1.201	
	Dissatisfied		-0.098		0.685	
	Un-decided		0.014		0.042	
	Satisfied		0.456		0.520	
	Very satisfied		0(a)		0(a)	
Housing characteristics	Very dissatisfied		-22.474		-20.400	-2.922
	Dissatisfied		-2.927*		-4.460*	-3.535*
	Un-decided		-2.077*		-3.415*	-2.141*
	Satisfied		-0.849		-1.528*	-1.034*
	Very satisfied		0(a)		0(a)	0(a)
Social-economic factors						
Age				-0.005	-0.022	
Education				-0.005	0.024	
Sex	Female			-0.026	-0.744	
	Male			0(a)	0(a)	

Table 7.12 - Continued						
		Model 1	Model 2	Model 3	Model 4	Model 5
Kids	None			-0.047	-0.692	
	One			-0.071	-0.172	
	Two			-0.028	0.222	
	Three			-0.152	-0.628	
	More than three			0(a)	0(a)	
Pets	None			-1.442*	-1.369*	-1.234*
	One			-0.630	-0.578	-0.765
	Two			-0.461	-0.903	-0.695
	Three			-0.688	0.266	-0.640
	More than three			0(a)	0(a)	0(a)
Ownership of house	No			0.367	0.341	
	Yes			0(a)	0(a)	
Accommodation type	Single family home			0.865	1.028	
	Mobile home			0.861	2.820*	
	Apartment			0.835	1.236	
	Other			0(a)	0(a)	
Occupation	Employed			-0.971	-0.549	
	Part-time			0.155	0.723	
	Unemployed			-1.894	-3.399*	
	Retired			0.431	0.256	
	Student			-1.002	-0.495	
	Others			0(a)	0(a)	
Test of parallel lines	*p*	0.011	0.390	0.797	1.000	0.043
Goodness-of-Fit	*p*	0.265	0.096	0.921	0.997	0.127
*Significant at $\alpha = 0.05$. a: The reference category.						

Estimated coefficients from ordinal regression

Most of the variables in the regression models produced by the complementary log-log link function and the logit link functions exhibit similar relationships (Table 7.11 and Table 7.12). A few of the variables (i.e. have undertaken actions, location-related hazards characteristics, and the presence of children), however, show different relationships in the models.

Estimated coefficients from model one indicate that residents who were not threatened by floods, who did not plan to relocate to a non-flood-prone area, and whose homes have not been flooded, are more likely to assign a higher level of satisfaction with their home location than their neighbors who were threatened by floods, wanted to relocate, and who have experienced flood (Tables 7.11 and 7.12 Model 1). Having been threatened by floods and having an intent to relocate are significantly related with ERS.

Almost all coefficients in model two have negative signs (Tables 7.11 and 7.12 Model 2). This indicates that compared with residents who selected category *very satisfied*, all other lower categories selectors are less likely to rate a higher satisfaction with their location. This meets the expectation that residents who are less satisfied with location-related and housing characteristics are less likely to hold a positive attitude toward their residential environment. In other words, the lower the category is selected by a resident, the less likely the resident is satisfied with his or her home location. Similar to the regression results of survey question 1, natural amenities and house characteristics are the only factors statistically significant with ERS. The coefficients of age and education are so small that they have very little impact on the assignment of residential satisfaction. Sex and pets both have negative signs and only the possession of

pets is related to residential satisfaction. Renters, part-time employees, and retired people are more likely to assign a higher satisfaction rating than the other categories. All of the accommodation types examined here seem more likely to rate their location satisfied compared to referred categories, *other* (Tables 7.11 and 7.12 Models 3 and 4). In model four, accommodation type is identified as a contributor to ERS. The results of parallel line tests and model fitting indicate that models three and four are better fits of the observed data than are the other three models.

Model Validation

The predicted residential satisfaction is statistically associated with the expressed satisfaction (Tables 7.13 and 7.14). The strengths of the associations vary (The value range of Kendall's tau-b is 0.214 - 0.673 and the value range of Kendall's tau-c is 0.138 - 0.518). The classification tables (Tables 7.13 and 7.14) show that the category, *very satisfied*, has been best predicated by models. The range of correct predication of this category by models with complementary log-log function is from 86.3 to 90.7 percent, and by models with logit function is from 83.6 percent to 90.4 percent (Tables 7.13 and 7.14). Other categories have been predicted poorly. Most models failed to predict the category *dissatisfied*.

Since more than half of the respondents who chose *satisfied* are mis-predicted as *very satisfied*, to improve the model, two satisfied categories was merged. So did other categories (e.g., two dissatisfied categories, categories in kids and pets). The mode-fitting information and test of parallel lines suggest that models with merged categories are not better than the former models (Table 7.16). The model identifies four variables:

Table 7.13 Model Validation-4 (Models with Complementary log-log Link Function)

		Residents expressed residential satisfaction (ERS) (Q17)										Total	
		Very dissat.		Dissatisfied		Un-decided		Satisfied		Very sat.			
		Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)
Model 1: PRS[1]	Un-decided	1	25.0	1	14.3	4	16.7	2	5.0	2	2.7	10	6.7
	Satisfied	2	50.0	0	0.0	10	41.7	5	12.5	5	6.7	22	14.7
	Very satisfied	1	25.0	6	85.7	10	41.7	33	82.5	68	90.7	118	78.7
Model 2: PRS[2]	Very dissat.	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7
	Dissatisfied	0	0.0	1	14.3	0	0.0	0	0.0	0	0.0	1	0.7
	Un-decided	1	25.0	3	42.9	10	40.0	3	7.7	0	0.0	17	11.5
	Satisfied	1	25.0	1	14.3	9	36.0	13	33.3	10	13.7	34	23.0
	Very sat.	1	25.0	2	28.6	6	24.0	23	59.0	63	86.3	95	64.2
Model 3: PRS[3]	Satisfied	3	75.0	2	33.3	7	30.4	8	20.5	8	11.0	28	19.3
	Very sat.	1	25.0	4	66.7	16	69.6	31	79.5	65	89.0	117	80.7
Model 4: PRS[4]	Very dissat.	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7
	Dissatisfied	0	0.0	2	33.3	0	0.0	0	0.0	0	0.0	2	1.5
	Un-decided	3	75.0	1	16.7	11	52.4	1	2.8	0	0.0	16	11.9
	Satisfied	0	0.0	0	0.0	8	38.1	19	52.8	7	10.3	34	25.2
	Very sat.	0	0.0	3	50.0	2	9.5	16	44.4	61	89.7	82	60.7
Model 5: PLS[5]	Dissatisfied	0	0.0	0	0.0	1	4.2	0	0.0	0	0.0	1	0.7
	Un-decided	2	50.0	2	28.6	6	25.0	4	10.5	1	1.3	15	10.1
	Satisfied	1	25.0	3	42.9	8	33.3	10	26.3	9	11.8	31	20.8
	Very sat.	1	25.0	2	28.6	9	37.5	24	63.2	66	86.8	102	68.5

*Percentage of predicated residential satisfaction within the expressed satisfaction.

[1]Kendall's tau-b = 0.334, Kendall's tau-c = 0.241, all significant at $\alpha = 0.05$. [2]Kendall's tau-b = 0.513, Kendall's tau-c = 0.375, all significant at $\alpha = 0.05$. [3]Kendall's tau-b = 0.242, Kendall's tau-c = 0.217, all significant at $\alpha = 0.05$. [4]Kendall's tau-b = 0.641, Kendall's tau-c = 0.480, all significant at $\alpha = 0.05$. [5]Kendall's tau-b = 0.434, Kendall's tau-c = 0.322, all significant at $\alpha = 0.05$.

Table 7.14 Model Validation-5 (Models with Logit Link Function)

		Residents expressed residential satisfaction (Q17)										Total	
		Very dissat.		Dissatisfied		Un-decided		Satisfied		Very satisfied			
		Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)	Count	(%*)
Model 1: PRS[1]	Un-dec.	1	25.0	1	14.3	6	25.0	2	5.0	4	5.3	14	9.3
	Satisfied	2	50.0	3	42.9	9	37.5	7	17.5	7	9.3	28	18.7
	Very sat.	1	25.0	3	42.9	9	37.5	31	77.5	64	85.3	108	72.0
Model 2: PRS[2]	Very Dis.	1	25.0	1	14.3	0	0.0	0	0.0	0	0.0	2	1.4
	Un-dec.	1	25.0	3	42.9	12	48.0	3	7.7	2	2.7	21	14.2
	Satisfied	1	25.0	1	14.3	8	32.0	13	33.3	10	13.7	33	22.3
	Very sat.	1	25.0	2	28.6	5	20.0	23	59.0	61	83.6	92	62.2
Model 3: PRS[3]	Un-dec.	2	50.0	1	16.7	2	8.7	0	0.0	3	4.1	8	5.5
	Satisfied	1	25.0	0	0.0	4	17.4	7	17.9	4	5.5	16	11.0
	Very sat.	1	25.0	5	83.3	17	73.9	32	82.1	66	90.4	121	83.4
Model 4: PRS[4]	Very dis.	1	25.0	1	16.7	0	0.0	0	0.0	0	0.0	2	1.5
	Dissatisfy	1	25.0	1	16.7	1	4.8	0	0.0	0	0.0	3	2.2
	Un-dec.	2	50.0	1	16.7	11	52.4	1	2.8	1	1.5	16	11.9
	Satisfied	0	0.0	3	50.0	8	38.1	18	50.0	8	11.8	37	27.4
	Very sat.	0	0.0	0	0.0	1	4.8	17	47.2	59	86.8	77	57.0
Model 5: PRS[5]	Very dis.	1	25.0	0	0.0	1	4.2	0	0.0	0	0.0	2	1.3
	Un-dec.	2	50.0	4	57.1	9	37.5	6	15.8	1	1.3	22	14.8
	Satisfied	0	0.0	1	14.3	9	37.5	9	23.7	10	13.2	29	19.5
	Very sat.	1	25.0	2	28.6	5	20.8	23	60.5	65	85.5	96	64.4

*Percentage of predicated residential satisfaction within the expressed satisfaction.
[1]Kendall's tau-b = 0.346, Kendall's tau-c = 0.277, all significant at $\alpha = 0.05$. [2]Kendall's tau-b = 0.495, Kendall's tau-c = 0.394, all significant at $\alpha = 0.05$. [3]Kendall's tau-b = 0.214, Kendall's tau-c = 0.138, all significant at $\alpha = 0.05$. [4]Kendall's tau-b = 0.673, Kendall's tau-c = 0.518, all significant at $\alpha = 0.05$. [5]Kendall's tau-b = 0.504, Kendall's tau-c = 0.391, all significant at $\alpha = 0.05$.

Table 7.15 Model Validation-6 (Models with Merged Category)

		ERS-Q17						Total	
		Dissatisfied		Un-decided		Satisfied			
		count	(%*)	count	(%*)	count	(%*)	count	(%*)
PRS[1] (Complementary log-logy):	Dissatisfied	5	50.0	2	9.5	0	0	7	5.2
	Un-decided	4	40.0	12	57.1	3	2.9	19	14.1
	Satisfied	1	10.0	7	33.3	101	97.1	109	80.7
PRS[2](Logit):	Dissatisfied	5	50.0	2	9.5	0	0	7	5.2
	Un-decided	4	40.0	11	52.4	4	3.8	19	14.1
	Satisfied	1	10.0	8	38.1	100	96.2	109	80.7

*Percentage of predicated residential satisfaction within the expressed satisfaction.
[1]Kendall's tau-b = 0.758, Kendall's tau-c = 0.399, all significant at $\alpha = 0.000$.
[2]Kendall's tau-b = 0.720, Kendall's tau-c = 0.378, all significant at $\alpha = 0.000$.

Table 7.16 Results of Ordinal Regressions-6
(DV: ELS from Q17; IV: Using merged category)

Variables		Model (Complementary log-log)	Model (Logit)
Threatened by floods	No	1.076	1.325
	Yes		
Undertaken actions	No	-0.593	-0.678
	Yes		
Relocation intention	No	2.717*	2.886*
	Yes		
Flooded home	No	1.183	1.651
	Yes		
Location-related Characteristics			
Natural Amenities	Very dissatisfied	-	-
	Dissatisfied	0.518	0.726
	Un-decided	-0.941	-1.519
	Satisfied	-0.725	-1.001
	Very satisfied	0(a)	0(a)
Social Amenities	Very dissatisfied	-	-
	Dissatisfied	-7.881	-24.199
	Un-decided	-4.538*	-4.919*
	Satisfied	-2.031	-2.049
	Very satisfied	0(a)	0(a)
Hazards characteristics	Very dissatisfied	1.021	0.694
	Dissatisfied	1.304	1.642
	Un-decided	1.564	1.483
	Satisfied	1.650	1.464
	Very satisfied	0(a)	0(a)
Housing characteristics	Very dissatisfied	-2.961	-17.937
	Dissatisfied	-2.400	-3.008
	Un-decided	-0.835	-1.047
	Satisfied	0.118	0.230
	Very satisfied	0(a)	0(a)
Social-economic factors			
Age		-0.016	-0.013
Education		0.148	0.164
Sex	Female	-0.672	-0.864
	Male		0(a)
Kids	None	-0.645	-1.121
	Yes		0(a)
Pets	None	-0.554	-0.814
	Yes		0(a)

Table 7.16 - Continued			
		Model (Complementary log-log)	Model (Logit)
Ownership of house	No	-0.286	-0.680
	Yes		0(a)
Accommodation type	Single family home	0.965	1.151
	Mobile home	3.982*	4.685*
	Apartment	0.952	1.501
	Other	0(a)	0(a)
Occupation	Employed	-0.234	-0.011
	Part-time	1.377	1.816
	Unemployed	-4.563*	-4.695*
	Retired	0.554	1.007
	Student	-1.613	-0.766
	Others	0(a)	0(a)
Test of parallel lines	*p*	1.000	0.392
Goodness-of-Fit	*p*	0.449	0.995
*Significant at $\alpha = 0.05$. a: The reference category.			

relocation intention, social amenities, accommodation type, and occupation. Some estimated coefficients of each variable show a similar pattern as models with separated categories: residents do not have a pet(s) or a child(ren) are less likely to rate a higher satisfaction of their location than those who have them; female and non-home owner are less likely to assign a higher satisfaction of their home location compared with male and homeowner respectively; part-time employees and retired people are more likely to rate a higher level of satisfaction (Table 7.16). Others, some location-related variables, show different patterns. For example, the new models indicate that people selected lower level of satisfaction with hazards-related issues are more likely to assign a higher satisfaction of their home location (Table 7.16)

Efficiency of link function

Comparing the values of model-fitting information, the pseudo r-square, and percentage of correct predication of *very satisfied*, I find that the models performed quite similarly (Table 7.17). I prefer the complementary log-log model because it is consistent with the link function used to predict the general expression of residential satisfaction from survey question one.

7.3 LOCATIONAL AMENITIES VS. ACCEPTANCE OF HIGHER FLOOD-RISK

This section presents the results of the logistic regressions of location-related amenities and acceptance of higher flood risks. The Cox and Snell R^2 and Nagelkerke R^2 measure how well the model predicted the values of the dependent variables, the higher

Table 7.17 Efficiency of Link Functions-2

Complementary log-log					Logit				
Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Model fitting information: Value of Chi-Square									
25.353*	89.052*	17.694	175.625*	69.112*	31.539*	71.668*	20.151	102.731*	70.532*
Pseudo R-Square: value of Cox and Snell									
0.156	0.452	0.115	0.728	0.371	0.190	0.384	0.130	0.533	0.377
Test of parallel lines: significance level									
0.003	0.015	0.574	1.000	0.021	0.011	0.390	0.797	1.000	0.043
Percentage of correct predication on category *very satisfy*									
78.7	64.2	80.7	60.7	68.5	72.0	62.2	83.4	57.0	64.4
*Significant at $\alpha = 0.05$.									

values indicating better model fit. The Hosmer and Lemeshow value measures the correspondence of the actual and predicated values of the dependent variable. A good model fit is indicated by a non-significant chi-square value (Norusis 2003, 321-362). Because it is difficult to interpret the estimated coefficient of a categorical data set, I will interpret the estimated odds ratio[9] of the variables in the analysis. An odds-ratio value larger than 1 indicates that the probability of an event occurring has increased, while a value less than 1 means that the probability of an event occurring has decreased. The probability of an event occurring has unchanged if the value of odds ratio is close to 1.

The dependent variables in logistic regression models are the residents' expressed willingness to accept higher flood risk in order to be closer to location-related natural or social amenities (survey questions 18 and 19). The independent variables in model one included perception of flood risk, preparation of the risk, and flooding experiences. Model two evaluated the importance of location-related characteristics: natural amenities, social amenities, and hazards characteristics. Six social-demographic variables were included in model three: age, years of education, sex, presence of children or pets, and race (Hispanic or Latino, White, and others). Model four included all variables in the first three models.

7.3.1 Natural Amenities vs. Acceptance of Higher Flood Risk

Model four had the highest R-squared values (Negelkerke $R^2 = 0.134$, Cox and Snell $R^2 = 0.097$) and the significant level of chi-squared value for the Hosmer and Lemeshow test was acceptable ($p = 0.429$). In addition, model four had the highest

[9] The odds of an event occurring is defined as the ratio of the probability that an event occurs to the probability that it does not

overall percentage of correct prediction (72.5 percent) (Table 7.18). The aforementioned overall model-fitting information indicates that model four is the best regression model to predict whether residents were willing to accept higher flood risk in order to be closer to natural water-related amenities. In the following section, I will interpret the meaning of the odds ratio in model four.

Perception of flood, flood preparation, and flood experience

Compared to residents who were threatened by floods, those who were not threatened were less likely to (8 percent lower) to accept a higher flood risk in order being closer to natural water-related amenities. However, the value of odd ratio (0.924) was so close to 1 that the probability of acceptance of higher flood risk in order to be closer to natural water-related amenities between compared groups (residents threatened by floods vs. residents not threatened by floods) did not have a significant change. That is, the perceived threat of floods does not significantly influence residents' residential choice if only considering location-related natural water-related amenities and accompanied flood risk.

Compared to residents who attempted to mitigate flood risk or flood damage, those who have not taken any actions were 51 percent less likely to accept a higher flood risk. In other words, residents who have prepared for the flooding are more likely to accept a higher risk than those have not. Residents who did not purchase flood insurance were 13 percent more likely to accept a higher risk than their counterparts. This was not expected. The original expectation was that residents who purchased flood insurance

Table 7.18 Logistic Regression of Natural Amenities and Acceptation of a Higher Flood Risk

Variables	Model 1 (N = 147)		Model 2 (N = 154)		Model 3 (N = 145)		Model 4 (N = 138)	
	B	Exp (B)	B	Exp (B)	B	Exp (B)	B	Exp (B)
Threatened by floods (no)[1]	.109	1.116					-.079	.924
Undertaken actions (no)[1]	-.453	.636					-.714	.490
Flood insurance (no)[1]	-.014	.986					.122	1.130
Relocation intention (no)[1]	-.004	.996					-.110	.896
Flooded home (no)[1]	.291	1.337					-.202	.817
Flooded street (no)[1]	.059	1.061					.017	1.017
Natural amenities (dissatisfied)[2]			-1.200	.301			-1.288	.276
Natural amenities (Un-decided)[2]			-.523	.593			-1.025	.359
Social amenities (dissatisfied)[2]			-19.358	.000			-20.127	.000
Social amenities (Un-decided)[2]			.737	2.089			.516	1.676
Hazards characteristics (Dissatisfied)[2]			.153	1.165			.148	1.159
Hazards characteristics (Un-decided)[2]			.160	1.174			-.002	.998
Education (in years)					0.006	1.006	.004	1.004
Age (years)					-0.031*	0.969	-.036*	.964
Sex (female)[3]					0.170	1.186	.190	1.209
Pets (none)[4]					-0.018	0.983	.217	1.243
Kids (none)[4]					-0.002	0.998	-.078	.925
Race (Hispanic/Latino)[5]					1.126	3.084	1.559	4.752
Race (White)[5]					0.857	2.356	1.250	3.490
Constant	-0.696*	0.499	-7.475	0.001	0.246	1.279	-6.390	0.002
Hosmer and Lemeshow Test Sig.	0.452		0.944		0.559		0.429	
Cox and Snell R square	0.009		0.027		0.059		0.097	
Nagelkerke R square	0.012		0.038		0.086		0.134	
Overall percentage correct	66.7		68.2		68.3		72.5	
Reference category [1] yes, [2] satisfy, [3] male, [4] yes, [5] others. *Significant at $\alpha = 0.05$.								

were more likely to live closer to surface water, which not only providing them access to natural water-related amenities, but also increased flood risk. So, why does the estimated coefficient show such a surprising result? Possible reasons may include residents' flood experiences, personal belief in the value of flood insurance, other investments in protective measures, and there may be others.

Residents who did not plan to relocate their homes were about 10 percent less likely than those who planned to relocate to accept a higher risk in order to live closer to natural water-related amenities (the value of odds ratio was 0.896). This means that people who want to relocate homes are more likely to accept a higher risk in order to be closer to water-related natural amenities. This was also unexpected. However, since there only a few residents who planned to move because they were threatened by location-related flood problems (as mentioned in Chapter 6), this finding seems acceptable.

Experience with street- or yard-flooding does not appear to change residents' willingness to accept higher flood risk (odd ratio was 1.017). Interestingly, compared to residents whose homes have been flooded, those whose homes have not been flooded since they moved in were less likely to accept higher flood risk (18 percent lower). This indicates that the different levels of flood experience have different effects on residents' perceptions of risk and their selection of residential location.

Location-related amenities and hazards characteristics

Residents who were dissatisfied with and who have not decided their level of satisfaction toward location-related natural amenities near their homes were less likely

than those who were satisfied with natural amenities to accept a higher risk in order to be close to the natural amenities. This confirms previous studies. Because of the relative scarcity of location-related natural amenities, people who desire location-related natural amenities often care less about the location-related risks (Chen 2007; Luttik 2000).

Compared to residents who were satisfied with their location-related social amenities, those who were dissatisfied with social amenities were less likely to accept higher risks; those who have not decided their level of satisfaction toward location-related social amenities were more likely to accept a higher risk in order to be closer to the social amenities.

Residents who were dissatisfied with location-related-hazards were more likely to accept a higher risk to be closer to the natural amenities than those who were satisfied with the location-related hazards issues. This reveals a contrast in thinking: some residents dislike the hazards around their home but decide they must accept a higher risk in order to be closer to natural amenities. The odds-ratio of residents who did not have a clear feeling about the hazards issues around their home was no different from those who were satisfied with the level of flood risk around their home.

Social-demographic factors

Age and educational level did not influence whether residents would be more likely to accept a higher risk to be closer to natural amenities. Women were 21 percent more likely to accept a higher risk in order to be closer to their preferred natural amenities. Households with pets were more likely to accept higher risk than those who did not have pets, while living with or without children did not seem to have an effect on

people's choices regarding location-related hazards and natural amenities. Hispanic/Latino and White people were more likely than other ethnic groups to accept a higher risk to live in a place with natural amenities.

7.3.2 Social Amenities vs. Acceptance of Higher Flood Risk

The model-fitting information shows that model two had the highest correct prediction (76.1%), but the significance level of the Hosmer and Lemeshow test was too small to be accepted ($p = 0.003$). I chose to interpret the meanings of the coefficient and odds ratio in model four because it has the highest R-squared values (Negelkerke $R^2 = 0.168$, Cox and Snell $R^2 = 0.114$, an acceptable significance level of the Hosmer and Lemeshow test ($p = 0.684$), and a reasonable percentage of correct predication (74.6%) (Table 7.19).

Perception of flood, flood preparation, and flood experience

Residents who were not threatened by floods, who have not taken actions to prevent flooding and potential damages, who have not planned to relocate, and whose homes have not been flooded were less likely to accept a higher flood risk in order to be closer to location-related social amenities when compared to their counterparts. While residents who have not purchased flood insurance and who have not experienced yard- or street-flooding were more likely to accept a higher risk in order to be closer to their preferred location-related social amenities.

Table 7.19 Logistic Regression of Social Amenities and Acceptation of a Higher Flood Risk

Variables	Model 1 (N = 148)		Model 2 (N = 155)		Model 3 (N = 149)		Model 4 (N = 142)	
	B	Exp (B)	B	Exp (B)	B	Exp (B)	B	Exp (B)
Threatened by floods (no)[1]	-.056	.946					-.584	.557
Undertaken actions (no)[1]	-.259	.772					-.233	.792
Flood insurance (no)[1]	.084	1.087					.376	1.457
Relocation intention (no)[1]	-.926*	.396					-1.218*	.296
Flooded home (no)[1]	.269	1.309					-.273	.761
Flooded street (no)[1]	.194	1.214					.320	1.376
Natural amenities (dissatisfied)[2]			-20.108	.000			-21.184	.000
Natural amenities (Un-decided)[2]			.381	1.464			.078	1.081
Social amenities (dissatisfied)[2]			.177	1.194			-.635	.530
Social amenities (Un-decided)[2]			.361	1.435			.502	1.652
Hazards characteristics (Dissatisfied)[2]			-.246	.782			-.602	.548
Hazards characteristics (Un-decided)[2]			-.383	.682			-.725	.484
Education (in years)					0.003	1.003	.002	1.002
Age (years)					-0.022	0.978	-.032*	.969
Sex (female)[3]					-0.052	0.949	.281	1.325
Pets (none)[4]					-0.371	0.690	-.328	.721
Kids (none)[4]					-0.113	0.893	.103	1.109
Race (Hispanic/Latino)[5]					0.141	1.151	.601	1.824
Race (White)[5]					0.488	1.628	.590	1.804
Constant	-0.880*	0.415	-7.632	0.000	-0.325	0.723	1.797	6.030
Hosmer and Lemeshow Test Sig.	0.968		0.003		0.141		0.684	
Cox and Snell R square	0.032		0.034		0.039		0.114	
Nagelkerke R square	0.048		0.051		0.057		0.168	
Overall percentage correct	75.0		76.1		75.2		74.6	
Reference category [1] yes, [2] satisfy, [3] male, [4] yes, [5] others. *Significant at $\alpha = 0.05$.								

Location-related amenities and hazards characteristics

Compared to residents who were satisfied with location-related amenities, those who were not satisfied were less likely to accept a higher risk in order to be closer to some social amenities. The difference between those who were satisfied with location-related natural amenities and those who were undecided about location-related natural amenities is not great and it has little influence on the odds ratio of whether to accept a higher risk in order to be close to natural amenities. Residents who were unsure of their satisfaction with location-related social amenities were more likely than those who were satisfied with social amenities to accept a higher risk in order to be close to the natural amenities. Residents who were dissatisfied with and unsure of their location-related hazards issues were less likely than those who were satisfied with their location-related hazards issues to accept higher flood risk.

Social-demographic factors

Age and educational level have little influence on whether residents are willing to accept a higher flood risk to be closer to social amenities. Females are more likely than males to accept higher risk in order to be closer to their preferred social amenities. Households without pets are less likely to accept a higher risk than those who had pet(s), while those living without young kid(s) are more likely to accept a higher risk than those living with kid(s) in order to be closer to their desired social amenities. Compared to other ethnic groups, Hispanic/Latino and White people are more likely to accept a higher risk in order to live in a place with social amenities.

7.4 SUMMARY

- Compared to their counterparts, residents who were aware of flood risk were more satisfied with their home location and location-related natural amenities and were more likely to accept a higher flood risk in exchange for location related benefits.
- Location-related benefits (e.g., natural amenities, housing, and social amenities) are positively related with residential satisfaction; while perceived flood threats reduce residential satisfaction. This suggests that location-related functional advantages and displaceable natural amenities are the major attractions of floodplain dwelling.
- Perceived flood threats, protective action, flood experiences, and intent to relocate affect residential satisfaction ratings.
- Perceived flood threats did not affect residents' choices between higher flood risk and desired natural amenities but influenced the choices between higher flood risk and desired social amenities.
- Residents who did not undertake protective actions were less likely to accept a higher flood risk in exchange for location-related benefits than their counterparts; while those who did not purchase flood insurance were more likely to accept higher flood risk than those who were protected by flood insurance.
- Flood experiences affect people's choice between a lower safety level and desired benefits.
- The decision to relocate did not significantly influence the acceptance of higher flood risk in exchange for natural amenities, but it did affect the probability of acceptance of higher risk for social amenities.

- Compared to residents who were satisfied with location-related characteristics, those who were dissatisfied were less likely to accept a higher chance of flood risk in exchange for location-related benefits, while those who were neither satisfied nor dissatisfied in general either decrease the probability or did not influence the acceptance of higher risk for desired location-related benefits.
- Pet ownership was statistically related to residents' rate of residential satisfaction.
- Sex, race, parenthood, and pet ownership affected residents' acceptance of a higher chance of flood risks in order to be closer to location-related benefits.

CHAPTER 8

DISCUSSIONS AND CONCLUSIONS

This chapter discusses the significance and the managerial and policy implications of this study. It also identifies the theoretical and methodological limitations of the study that should be addressed in future research. Finally, conclusions of the study are enumerated based on the previously discussed analyses.

8.1 DISCUSSIONS

This dissertation studies floodplain residents' attitudes toward their residential environment by considering location-related benefits and hazards. More specifically this study examines the relationships between the level of residential satisfaction and possible contributors to satisfaction, between the levels of residential satisfaction and awareness of location-related benefits and risks, and between risk awareness and acceptance of higher risk for location-related benefits.

Findings derived from comparisons of floodplain residents' perceived residential satisfaction and contributors to their residential satisfaction suggest that location-related benefits and location-specific hazards affect perceived residential satisfaction, residential

preference, and risk acceptance. Most survey respondents (86 percent) were satisfied with their current residential location in general. Even when residents considered location-related disadvantages and risk of flooding, 76 percent of them claimed that they were satisfied with their home locations. The presence of natural and social amenities, perceived low probability of flooding, low awareness of potential flood risk, and lack of flood experience each contributed to the high percentage of residential satisfaction. In addition, cognitive adjustments may also influence perceptions of residents' satisfaction of their residential locations. As in other studies, residents frequently mentioned the functional advantages of their residential location but seldom referred to disadvantages (Kauko 2006a). The location-related characteristics – listed in order of importance to producing satisfaction – were housing characteristics, social amenities, natural amenities, and hazards characteristics. This confirms the conclusions of previous research that residents emphasize the functional and tangible factors more than location-related, intangible ones (Kauko 2006a; Philips, Siu, and Yeh 2005).

Comparing expressed residential satisfaction from survey questions 1 and 17, it is clear that location-related hazard has only a limited influence on residential satisfaction. This suggests that the location-related benefits are greatly appreciated and unlikely to be overshadowed by location-related hazards. Natural amenities and social amenities are two location-related benefits that were examined in this study. The regression models suggest that natural amenities were statistically significant contributors to residential satisfaction and that the more positive the attitudes residents possessed toward location-related natural amenities, the more likely residents were to be satisfied with their residential location. This conclusion was expected, as it reflects the importance of the

wide range of benefits that American homeowners accrue from nature (Fjortoft and Sageie 2001; Talbot, Bardwell, and Kaplan 1987). It also confirms the importance of the natural environment to residential satisfaction (Sullivan 1994; Frey 1981). A study conducted by Kaplan (1985) suggests that residential satisfaction can be achieved even in the multiple-family housing context through the effective use of the natural environment. Both residents' perceptions of their flood exposure and their intentions to relocate significantly influence their satisfaction. Compared to their counterparts, residents whose properties were not threatened by flooding and who did not plan to relocate were more likely to express higher levels of residential satisfaction.

Less than one-third of the study population undertook mitigating actions to prevent flood damage, and less than half purchased flood insurance. The International Commission for the Protection of the Rhine (2002) estimates that self-protective behavior by residents of flood-prone urban areas can reduce monetary flood damage by 80 percent and reduce the need for public risk management. Previous research has shown that the lack of information about risks, damages, costs and benefits is the major reason why some residents do not take precautionary action. Other possible explanations need to be explored.

In addition, although more than 30 percent of residents planned to relocate, only 21 percent of them intended to move to non-flood-prone areas. These findings suggested that floodplain residents in San Marcos, Texas, do not seriously consider location-specific hazards when choosing a home location or when evaluating their residential location. Perhaps, flood control projects across the upper San Marcos River which have successfully alleviated flood risk in the city and elevation of properties have justified

residents' perceptions of location-related hazards. However, San Marcos, a particularly flood prone city, will eventually experience another major flood like those that occurred in 1998 and 2001 (Georgiou 2008) – the next flood will further challenge common perceptions about safety.

Risk awareness is rather poor. Only 51 percent of the respondents in this study were aware of flood risk before moving into their current houses. This proportion was unexpected and inconsistent with the findings of other research (Collins 2005; Cross 1990). Moreover, only 40 percent of survey participants knew that they were living in a floodplain, while more than one third of them were certainly unable to distinguish the limits of the 100- or 500-year floodplains. After so many years of efforts to educate the public about disasters and the management of floodplains (Burby 2001; White, Kates, and Burton 2001; Cross 2000; Kates 1962), why are there still so many floodplain residents who either do not understand or misunderstand the flood risks of their residential spaces? One possible explanation is that some survey participants were new in-migrants who have not yet become familiar with the physical environment of their homes. Unfortunately, the survey questionnaire did not ask questions regarding the tenure of residence, so it is impossible to identify whether or not those survey participants were new to the area.

Because a majority of survey respondents were educated (about 86 percent of study participants graduated from higher school and 46 of the total also graduated from college), however, even if they were newcomers one should expect them to be aware of the hazards around their residences. Does this question the effectiveness of hazards- or disaster-education programs on environmental perception and awareness of public?

More examination of the effectiveness of hazards- or disaster-education programs, along the lines of Karanci and others's (2005) work in Turkey, is needed. Another possible explanation is that survey respondent did not treat this question seriously. This is a common problem related to surveys as data collection tools and this will be discussed in the next section.

This study finds that awareness of flood risk influences residential satisfaction. Residents who were aware of their home's potential exposure to flooding were more satisfied with their home location and location-related natural amenities, and were more likely to accept location-related risks compared to their counterparts. This highlights the importance of risk perception among hazard-zone residents. Awareness of risk to residential spaces helps occupants adopt protective actions, mitigate the potential threats, actively seek solutions, and reduce psychological stress.

Another important relationship uncovered in this study is that many respondents accept higher flood risk to gain immediate access to location-related benefits. It appears that more study participants were willing to accept higher risks in exchange for water-related natural amenities than for social amenities. Higher perceived flood risks had little effect on residents' acceptance of flood risk in exchange for natural amenities but it did affect the willingness to accept risk in exchange for social amenities. Compared to residents who were more threatened by floods (i.e. higher risk), those who were not threatened by floods were less likely to accept higher flood risk in exchange for greater access to social amenities. This was also unexpected but makes sense if those who were living with lower risk cared less about social amenities, or to state that differently, they did not want to decrease their level of safety just for social amenities.

As anticipated, residents who took no actions to prevent flood losses were less likely to accept higher flood risk in exchange for location-related benefits compared to their counterparts. However, that those who did not purchase flood insurance were more likely to accept higher floods risk than those who were protected by flood insurance was unexpected. Why were residents who did not have flood insurance more accepting of higher flood risk? Perception of low flood risk might be one explanation, but other explanations related to cost-benefit calculations of flood insurance need to be examined more fully through future research.

The decision of residents to relocate did not influence their acceptance of higher flood risk in exchange for natural amenities, but it did affect the acceptability of higher risk in exchange for social amenities. Compared to residents who planned to relocate their homes, those who were not planning to relocate were less likely to accept higher flood risk in exchange for social amenities.

Flood experience influenced residents' acceptance of higher flood risk for location-related benefits as well. Residents whose homes had not been flooded were less likely to accept higher risk for location-related benefits. Residents whose homes had been flooded might have adopted some protective actions to protect their homes, and their flood experiences allow them to accept higher risk of flood for location-related benefits. Residents who had not experienced flooded streets or yards were more likely to accept higher risk for social or natural amenities. This suggests that the intensity of flood experience affects people's risk acceptance.

Compared to residents who were satisfied (as well as those who were neither satisfied nor dissatisfied) with the characteristics of their residential setting, the

dissatisfied were less likely to accept higher flood risk for location-related benefits. There were some exceptions. For example, compared to those who were satisfied with location-related social amenities, residents who were neither satisfied nor dissatisfied with the social amenities were more likely to accept a higher chance of flood risk in exchange for location-related social and natural amenities. Residents who were dissatisfied with location-related hazards were 16 percent more likely to accept a higher chance of flood risk in order to live closer to desired natural amenities than those who were satisfied with location-related hazards. This finding indicated the internal conflict of floodplain residents between the desire for natural amenities and the perceived disadvantages of location-embedded risks.

Females were more likely to accept greater flood risk in exchange for location-related amenities than males. Compared to their counterparts, pet owners would accept more flood risk in exchange for natural amenities but not for social amenities, while parents would be less likely to accept higher risk of floods for social amenities but not for natural amenities. This seems to reflect the different emphases of pet owners and parents. The former would like to provide outdoor activities for their pets and the latter focus on the importance of the functional aspects (e.g., distance to school/day care, to retail stores, to health-care facilities, and friendly neighbors) of their homes as well as their perception of children's safety (Garling and Garling 1990).

Age and education levels did not appear to influence the acceptance of higher risk in order to live closer to desired location-related amenities. Compared to other ethnic groups, Hispanics or Latinos and Whites were more likely to expose themselves to a higher flood risk for location-based amenities, but this tendency was not statistically

significant. In addition, the category "other ethnic groups" in this study was under-represented (only seven people). Therefore the relationship of racial differences to residential satisfaction among floodplain dwellers cannot be drawn from this study. Nevertheless, considering the influence of culture on people's values, attitudes, and worldviews (Dake 1992; Douglas and Wildavsky 1982), it is very likely that racial differences may shape residential satisfaction (Tuan 1974).

8.2 LIMITATIONS AND FUTURE STUDIES

The relationships between residential satisfaction and location-related benefits and risks were examined with the goal of understanding both floodplain residents' attitudes toward the location of their homes and the homebuyers' views of location-related factors. This study has revealed the possible responses to dissatisfaction with residential environments, as well as the factors that could be modified to influence the level of residential satisfaction. Although the research questions have been answered, several theoretical and methodological limitations of this study must be acknowledged and addressed in future research.

The first limitation of this study was a product of the research topic itself – residential satisfaction. As mentioned earlier, residential satisfaction is a dynamic process that changes with changing needs and desires of residents. Needs and desires can be changed with changes of objective or subjective factors of residents and of their environment (including physical and social environments). For example, increased household income, functional change of nearby open spaces, graduation of children from high school, and other conditions may change not only the needs and desires of

residential location, but one's proximity to interior and exterior environments as well. There are so many possibilities that it is very likely that some important factors were not captured in this analysis of residential satisfaction. Because of this, unexpected or nonsensical findings might have been obtained and explains some of the inconsistent predictions of residential satisfaction (Amerigo and Aragones 1997).

In this study, residential satisfaction was measured by two questions: "How satisfied are you with the location of your current home?" and "Think about the location of your home. How satisfied are you with it as a place to live?" The former question was asked at the beginning of survey, the latter was asked after several questions focused on location-related flood problems. The question was included twice in order to determine residential satisfaction and how it may be affected by the characteristics of location-related hazards. This approach may not have been sensitive to the nuances of the idea of satisfaction. It is possible that the survey participants, when rating their satisfaction, took both location-related benefits and risks into account, regardless of other factors. This is frequently one of the drawbacks of using survey questionnaires to collect data: respondents may not express their actual thoughts about their residential environment when they fill out the survey (Morrow-Jones, Irwin, and Roe 2004; Morrison and McMurray 1999; Bunting and Guelke 1979). In spite of this drawback, the stated-preference approach (as opposed to revealed-preference studies) has been widely applied because of a number of advantages (Earnhart 2002; Louviere, Hensher, and Swait 2000; Hensher 1994). Validation studies have indicated that the stated-preference survey design statistically replicates the list of preferences unveiled by revealed preference methods (Kim, Pagliara, and Preston 2005).

Another methods-related limitation of this study is that the survey questions may have missed important issues. For instance, the survey did not include questions about the tenure of residence and therefore it was impossible to determine whether unrealistic risk perceptions were caused by a lack of familiarity with the resident's living environment or something else. Previous studies that have examined the relationships between environmental familiarity and length of residence indicate that there is no association between these variables (He 2007). Here, however, it is impossible to know whether there is any relationship because of the omission of tenure from this study. More work is needed to validate the relationships between environmental familiarity and length of residence. This study also asked residents to rank location-related characteristics while thinking about their decision to move into their current homes and their awareness of food risks before they moved into their current home. It was assumed that residents could accurately recall their knowledge and/or awareness, though this assumption might not have been a reasonable one.

All of these shortcomings should be and could be addressed in future studies. Furthermore, this study generated some research topics for future research. For instance, some pressing questions are: Why are people who live in a floodplain still unaware of flood risk? How can one develop safety programs that improve residents' knowledge of safety? How can we enhance risk- and disaster-education programs to prevent future flood damage and reduce loss of life? Are there other explanations for why some residents take protective actions while others do not? Do racial differences influence residential satisfaction? How can we promote more environmental awareness and hazard

safety among residents of hazardous areas? How can managers break residents' ties to their hazard-prone home locations and encourage them to move out of danger?

8.3 IMPLICATIONS

Despite these limitations, this study has contributed some new findings with respect to management of hazard-prone areas and the understanding of behavioral responses to hazards. The primary goal of hazard management is to reduce losses by encouraging residents to either relocate their houses or improve their residential environments (Burby and others 1999). Dissatisfaction with residential location has been documented as a necessary condition for relocation and adjustments of local conditions (Speare 1974; Wolpert 1966). It is therefore reasonable to infer that if residents who are dwelling in hazard-prone areas are dissatisfied with their residential settings they will either move away to reduce their hazard or they will stay and modify their home environments to reduce risk or exposure. Either way, the potential for loss caused by location-specific hazards will be reduced. Based on this inference, hazard managers could manage neighborhoods in ways that enhance (particularly increase) residents' dissatisfaction with their environment.

This study provides useful information for hazard-zone managers to achieve their goals. For instance, since household-, housing-, and location-related characteristics (including location-related benefits and hazards characteristics) have been found to be both significantly and independently related to various levels of residential satisfaction, changing single variables or factors may have an impact on overall levels of residential satisfaction. Thus, in order to decrease satisfaction to encourage relocation, floodplain

managers should work closely with hazard or emergency officers, and others who are in charge of planning and development of the city in terms of reducing location-related benefits and increasing residential risk perception.

8.4 CONCLUSIONS

We are assured that most floodplain residents (more than 75 percent) in the city of San Marcos, Texas are satisfied with their residential location despite of the location-related risk of flooding. Location-related functional advantages were the major attraction to dwell in the floodplain. The level of satisfaction with location-related natural amenities and housing characteristics were positively related to residential satisfaction; while perceived flood threats decreased residential satisfaction. Ownership of pet(s) is only the social-demographic characteristic statistically related to residents' residential satisfaction.

Moving out of a current home (about one-fifth of floodplain residents), adopting protective action (one-thirds of the entire study population), and purchasing flood insurance (less than half of survey respondents) were some of behavioral adjustments in response to dissatisfied residential location. The characteristics that were most related to residential preferences, in order of importance, were housing characteristics, social amenities, natural amenities, and hazards characteristics. Residents did not treat seriously the flood problems related to their current home locations because of their perceived low probability of flooding and their high appreciation for location-related benefits.

The rate of awareness of flood risk among floodplain dwellers before they moved into their current residential location was not as high as one might hope it to be (only 51

percent of study participants). Compared to their counterparts, residents who were aware of flood risk were more satisfied with their home location and location-related natural amenities and were more likely to accept a higher flood risk in exchange for location related benefits. More study participants are willing to accept a higher flood risk in order to live closer to water-related natural amenities than to social amenities. Perceived flood threats and decisions to relocate did not affect residents' choices between higher flood risks or desired natural amenities but influenced the choices between higher flood risks or desired social amenities. Residents who did not undertake protective actions were less likely to accept a higher flood risk in exchange for location-related benefits than their counterparts. Those who did not purchase flood insurance were more likely to accept higher flood risk than those who were protected by flood insurance. Flood experiences affect people's choices between lower safety levels and desired benefits.

Compared to residents who were satisfied with location-related characteristics, those who were dissatisfied were less likely to accept a higher chance of flood risk in exchange for location-related benefits, while those who were neither satisfied nor dissatisfied in general either worked to decrease the probability or did not influence the acceptance of higher risk for desired location-related benefits. Age and education did not affect residents' acceptance of higher risk of flood and desired location-related amenities. Age was the only social-demographic characteristic significantly related to the acceptance of higher risk for location-related amenities. Other characteristics, such as sex, race, parenthood, and ownership of pet affected residents' acceptance of a higher flood risks in exchange for proximity to location-related benefits but the connection seems to be statistically insignificant.

This study focuses on human dimension of interaction between natural systems and humans by investigating residential satisfaction among floodplain residents. It displays the struggles between perceived risk and desired residential location, and how people attempt to resolve these struggles. Natural system, a floodplain, is treated as a passive factor in this study, which not only provides relatively easier access to water-based recreation and natural amenities, but threats of flooding. Humans, floodplain residents, are treated as an active factor because they rate their residential satisfaction, adjust the level of satisfaction by undertaken flood protective actions, and choose their residential locations. The results of this study help us better understand the relationships between human and natural systems. For instance, those residents want to relocate to a non-flood prone area is an example of people's response to power of nature, while people who are willing to accept a higher chance of risk in order to be closer to location-related amenities is a result of the struggle between perceived risk and desired benefits. In a sum, if we assume that the study population, floodplain residents in the city of San Marcos, Texas, represents floodplain residents in the United States. Findings from this study indicate that (1) most floodplain residents are satisfied with their home location even considering location-related risk of flooding; (2) the most popular behavior adjustments to dissatisfied floodplain residential location include purchasing flood insurance, elevation floor, and moving out of the floodplain; (3) many floodplain residents either do not know or do not think that they are living in the floodplain, which suggests that floodplain residents are unaware of residential location-related risk of flooding; (4) awareness of location-related risk affects residents' residential satisfaction, whose who are aware of location-related risks are more likely to be satisfied with their home location

than their counterparts; (4) floodplain residents highly appreciate location-related natural amenities and they are more likely to accept a higher chance of risk in exchange for location-related natural amenities than social amenities.

APPENDIX A: COVER LETTER OF THE SURVEY

Survey of Home Location Satisfaction

November 25, 2007

Dear Resident (18 years old or above):

You are invited to participate in a survey conducted by a student from Texas State University-San Marcos. The survey was designed to examine what makes people satisfied with the location of their home.

Participation in this survey is voluntary and anonymous. It should only take about 10 minutes of your time.

Please complete and return the survey **before December 15, 2007** in the postage-paid envelope**.** The enclosed Chinese art is a gift to thank you for your participation. Also to thank you, a random drawing for $100 cash will be held by the end of 2007. All survey participants who complete and return the survey by **December 15, 2007** will be eligible to win a **$100 cash prize**!

If you would like more information about the survey, please feel free to call me at (512)-245-8642 or e-mail to XH1003@TXSTATE.EDU I will be happy to answer any questions you have regarding the study.

Thank you very much for helping with this important study!

Sincerely,

Elaine He
Department of Geography
Texas State University –San Marcos
601 University Dr.
San Marcos, TX 78666

Cuestionario de Satisfacción de Ubicación de Casa

25 de noviembre del 2007

Estimado Residente (mayor de 18 años):

Usted está invitado a participar en un cuestionario conducido por un investigador del University of Texas-San Marcos. Esta investigación fue diseñada para examinar lo que hace que la gente está satisfecha con la ubicación de su hogar.

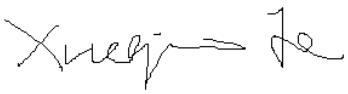
Su participación en este cuestionario es voluntaria y anónima. Esto cuestionario sólo le tomara aproximadamente 10 minutos de su tiempo.

Por favor complete y devuelva el cuestionario antes del **15 de diciembre de 2007** en el sobre de correo pre-pagado. La pieza de arte incluida es de China y es un regalo para compensarle por su participación. También para agradecerle, un ganador de **100 dólares** en efectivo será elegido al azar hacia finales de 2007. ¡Todos los participantes en la investigación que completen y devuelvan el cuestionario a más tardar el **15 de diciembre de 2007** serán elegibles para ganar el premio en efectivo de **100 dólares**! Será un ganador – ¿será usted?

Si desea tener más información sobre esta investigación, por favor siéntase libre de llamarme al teléfono (512)-245-8642 o en el correo electrónico: XH1003@TXSTATE.EDU. Yo estaré muy contenta de contestar cualquier pregunta que usted tenga en cuanto al estudio.

¡Muchas gracias por su ayuda en este importante estudio!

Sinceramente,



Elaine He
Departamento de Geografía
Texas State University-San Marcos
601 University Drive
San Marcos, TX 78666

APPENDIX B: SURVEY QUESTIONNAIRES

COMPLETE the survey and be eligible to

Win $100 cash!

Please note: *There are no right or wrong answers to this survey. The number on the survey is for geographical purpose only and your responses will remain anonymous. Please provide* ***your contact information*** *so I can notify you of the results of the random drawing for the $100 cash by the end of 2007.*

Mail address:_____ Or Email:_____

1. **How satisfied are you with the LOCATION of your current home?**
   - ❑ Very satisfied
   - ❑ Fairly satisfied
   - ❑ Neither satisfied nor dissatisfied
   - ❑ Slightly dissatisfied
   - ❑ Very dissatisfied

2. **Please explain why you are satisfied or dissatisfied with the location of your home.**

3. On a scale of 1 to 5, with **1 meaning very dissatisfied, 3 meaning no opinion, and 5 meaning very satisfied**, please circle the score that most closely reflects your opinion about YOUR CURRENT HOME LOCATION.

Are you satisfied with:	Very dissatisfied				Very satisfied
view from house/apartment?	1	2	3	4	5
quietness of the neighborhood?	1	2	3	4	5
availability of nearby parks and green space?	1	2	3	4	5
availability of nearby natural recreation opportunities (tubing, fishing, boating, etc.) ?	1	2	3	4	5
visual attractiveness of your house/apartment?	1	2	3	4	5
price or rent you paid for your house/apartment?	1	2	3	4	5
size of your house/apartment?	1	2	3	4	5
travel distance from your home to school/day care?	1	2	3	4	5
travel distance from your home to your/ your spouse's workplace	1	2	3	4	5
travel distance from your home to retail stores?	1	2	3	4	5
travel distance from your home to health-care facilities?	1	2	3	4	5
neighbors (Do you feel comfortable living near them?)	1	2	3	4	5
crime rate of your neighborhood?	1	2	3	4	5
potential for flood damage or losses caused by flooding?	1	2	3	4	5
your capability to recover from flood losses?	1	2	3	4	5
cost of flood insurance for your house or property?	1	2	3	4	5

COMPLETE el cuestionario y podrás ser elegible para

¡ Ganar 100 dólares en efectivo!

Aviso: No hay respuestas correctas o incorrectas en este cuestionario. El numero de cuestionario es para el seguimiento a las respuestas y sus respuestas permanecerán anónimas. Por favor proporcione su información de contacto para poder notificarle de los resultados al azahar en caso de ganar los 100 dólares al final del 2007.
Dirección:_____ o Email: _____

1. ¿Qué tan satisfecho está usted con la UBICACIÓN actual de su casa?
__Muy satisfecho
__ Apenas satisfecho
__Ni satisfecho ni descontentado
__Ligeramente descontentado
__Muy insatisfecho

2. Por favor explique porque está usted satisfecho o insatisfecho con la ubicación de su casa.

3. En una escala de 1 a 5, donde 1 es muy insatisfecho, 3 corresponde a que no opina, y 5 es que está muy satisfecho, por favor encierre en un circulo el resultado que más estrechamente refleja su opinión sobre LA UBICACIÓN DE SU CASA ACTUAL.

Está usted satisfecho con:	1=Muy insatisfecho				5=Muy satisfecho
¿vista de casa/apartamento?	*1*	*2*	**3**	*4*	*5*
¿tranquilidad del barrio?	*1*	*2*	**3**	*4*	*5*
¿disponibilidad de parques cercanos y zonas verdes?	*1*	*2*	**3**	*4*	*5*
disponibilidad de zonas de recreación naturales cercanas ¿(nadar, pescar, ir en canoa, etc.)?	*1*	*2*	**3**	*4*	*5*
¿con el atractivo visual de su casa/apartamento?	*1*	*2*	**3**	*4*	*5*
¿precio o alquiler que usted paga por su casa/apartamento?	*1*	*2*	**3**	*4*	*5*
¿tamaño de su casa/apartamento?	*1*	*2*	**3**	*4*	*5*
¿distancia de viaje su casa a las guardería infantil /escuela?	*1*	*2*	**3**	*4*	*5*
¿distancia de viaje de su casa a su trabajo o al de su esposa?	*1*	*2*	**3**	*4*	*5*
¿distancia de viaje de su casa a tiendas/mercados?	*1*	*2*	**3**	*4*	*5*
¿distancia de viaje de su casa a instalaciones de asistencia médica?	*1*	*2*	**3**	*4*	*5*
¿vecinos (se siente contento viviendo con ellos?)	*1*	*2*	**3**	*4*	*5*
¿promedio de delitos de su barrio?	*1*	*2*	**3**	*4*	*5*
¿posibilidades de inundaciones o pérdidas causadas por inundaciones?	*1*	*2*	**3**	*4*	*5*
¿su capacidad para reponerse por pérdidas en una inundación?	*1*	*2*	**3**	*4*	*5*

4. **Do you have plans to move to another location in the near future?**
   - ❑ No
   - ❑ Yes ↳ If yes, why?

5. **Thinking about your original decision to choose to live in this location, please rank the following factors, in order of importance and on a scale of 1 to 7 (with 1means "not important at all" and 7 means "extremely important" a decisive factor.)**

   (Not important) *1 2 3* **4** *5 6 7* ***(Extremely important factor)***

   _____ Scenic views, green space, clean air, quiet surroundings, and other natural features
   _____ Close to outdoor recreation (e.g., swimming, tubing, fishing, boating, hiking trails, skiing, access to river or lake, etc.) and natural beauties
   _____ Close to friends, family, or other social relationships
   _____ Close to work places, schools, retail and health care facilities, etc
   _____ Characteristics of the house (e.g., large lot, house size, price, architecture, etc.)
   _____ Exposure to natural hazards (e.g., flood, hurricane, wildfires, etc.)
   _____ Hazard-related management issues (insurance costs, potential for damages, need to elevate structure, fire resistance, etc.)

6. **Before you moved to your current home were you aware that you were moving to an area where a flood might occur?**
   - ❑ No
   - ❑ Yes

     ↳ If you knew that you were moving to a flood-prone area, which ONE of the following statements most closely corresponded to your opinion at that time?

     - ❑ The probability of flooding was very small.
     - ❑ The potential losses caused by floods were acceptable.
     - ❑ I was going to undertake actions to reduce flood losses.
     - ❑ I thought that the benefits of living here exceeded the threats from floods.
     - ❑ I had no other choice.
     - ❑ Other. Specify_____

7. **Do you feel threatened by potential flooding because of the location of your home?**
   ❑ No ❑ Yes

8. **Have you undertaken actions to prevent flooding or damages from floods?**
   - ❑ No
   - ❑ Yes ↳ What actions?

9. **Do you have any intention to relocate to a non flood-prone area?**
   - ❑ Yes ↳ If yes, why?

   - ❑ No ↳ If no, why not?

4. ¿Tiene usted planes de mudarse a otro lugar en el futuro cercano?
__ No __¿Sí? En caso de sí, por qué? _____

_____

5. Pensando en su decisión original de decidir vivir en esta ubicación actual, por favor clasifique los factores siguientes, por orden de importancia y en una escala de 1 a 7 (donde 1 significa "no es importante en absoluto" y 7 "muy importante" un factor decisivo.)

(No es importante) 1 2 3 4 5 6 7 (factor Muy importante)

_____ Vistas Panorámicas, las zonas verdes, aire puro, alrededores tranquilos, y otros rasgos naturales
_____ Cercanía con lugares al aire libre (p.ej, lugares para natación, tubo, pesca, andar en bote, caminatas, esquí, fáciles accesos a ríos o lagos, etc.) y bellezas naturales
_____ Cerca de amigos, familia, u otras relaciones sociales
_____ Cerca de sitios de trabajo, escuelas, tiendas e instalaciones de asistencia médica, etc.
_____ Características de la casa (p.ej, lote grande, tamaño de la casa, precio, arquitectura, etc.)
_____ Amenaza de desastres naturales (p.ej, inundaciones, huracanes, fuegos incontrolables, etc.
_____ Cuestiones administrativas sobre posibles riesgos (los gastos de seguros, potencial para daños, necesidades de elevar la estructura, la resistencia de fuego, etc.)

6. ¿Antes de que usted se mudara a su casa actual, usted era consciente qué usted viviría en un área dónde podrían ocurrir inundaciones?
__ No __Sí
¿Si usted sabía que usted se mudaba a un área propensa a inundación, cual de las declaraciones siguientes, correspondió estrechamente a su opinión entonces?

__ La probabilidad de inundación era muy pequeña.
__ Las pérdidas potenciales causadas por inundaciones eran aceptables.
__Yo iba a emprender acciones para reducir pérdidas de inundación.
__Pensé que las ventajas de vivir aquí excedían los riesgos de inundaciones.
__No tenía ninguna otra opción.
__Otro. Especifique_____

7. ¿Se siente usted amenazado por el riesgo de inundaciones debido a la localización de su casa?
__No __Sí

8. ¿Ha comencido usted acciones para prevenir inundaciones o daños de inundaciones?
__ No __Sí ¿Qué acciones? _____

_____

9. ¿Tiene usted intención de trasladarse a un área no propensa a inundaciones?

__Sí ¿ En caso de sí, por qué?_____

__No ¿Si no, por qué no?_____

10. **Has your current home been flooded since you moved in?** ❑ Yes ❑ No

11. **Have you ever experienced flooding in the streets or yards surrounding your residence (10 feet or more from your home)?** ❑ Yes ❑ No

12. **Does your household have flood insurance cover damages that may occur if your home and or belongings are destroyed by a flood?** ❑ Yes ❑ No

13. **The possibility of flooding for your home within the next year is:**
❑ Low ❑ Moderate ❑ High ❑ Very High ❑ Extreme ❑ Don't know

14. **The possibility of flooding for the area surrounding your residence (beyond 10 feet from your home) within the next year is:**
❑ Low ❑ Moderate ❑ High ❑ Very High ❑ Extreme ❑ Don't know

15. **The possibility of flooding for your surrounding neighborhood within the next year is:**
❑ Low ❑ Moderate ❑ High ❑ Very High ❑ Extreme ❑ Don't know

16. **The possibility of flooding occurring in San Marcos within the next year is:**
❑ Low ❑ Moderate ❑ High ❑ Very High ❑ Extreme ❑ Don't know

17. **Think about the location of your home. How satisfied are you with it as a place to live?** On a scale of 1 to 5, with 1 meaning very dissatisfied, 3 meaning neither dissatisfied nor satisfied, and meaning very satisfied. (Please circle ONE.)

(Very dissatisfied) *1 2* **3** *4 5* ***(Very satisfied)***

18. **Would you accept a higher chance of your home flooding in order to be closer to NATURAL amenities** (such as scenic views, proximity to outdoor recreation, etc.)**?**
❑ No ❑ Yes

19. **Would you accept a higher chance of your home flooding in order to be closer to SOCIAL amenities** (such as a shorter commute to work, friendly neighbors, proximity to a school or other public facilities, etc.) **?**
❑ No ❑ Yes

20. **Do you agree or disagree with the following statement?**

    a. **Homeowners have a responsibility to protect their homes from flooding.**
    ❑ Strongly disagree ❑ Disagree ❑ No opinion ❑ Agree ❑ Strongly agree

    b. **Government agencies have a responsibility to protect people and properties from flooding.**
    ❑ Strongly disagree ❑ Disagree ❑ No opinion ❑ Agree ❑ Strongly agree

21. **Do you live in a floodplain?**
❑ No
❑ Yes
    ↳ □ I live in the 100-year floodplain.
    ↳ □ I live in the 500-year floodplain.
    ↳ □ I don't know.
❑ I don't know

10. ¿Se ha inundado alguna vez su casa desde que se mudó allí? __Sí __No

11. ¿Hice alguna vez inundaciones en las calles o cuadras alrededor de su residencia (10 pies o más de su casa)? __Sí __No

12. ¿Tiene su casa seguro de daños por inundación que pueden ocurrir si su casa y/o pertenencias son destruidos por una inundación? __Sí __No

13. La posibilidad de inundación en su casa dentro del próximo año es:
___Bajo ___Moderado ___Alto ___Muy Alto ___Extremo ___No se

14. La posibilidad de inundación para el área que rodea su residencia (más allá de 10 pies de su casa) dentro del próximo año es:
___Bajo ___Moderado ___Alto ___Muy Alto ___Extremo ___No se

15. La posibilidad de inundación para su barrio circundante dentro del próximo año es:
___Bajo ___Moderado ___Alto ___Muy Alto ___Extremo ___No se

16. La posibilidad de que ocurran inundaciones en San Marcos dentro del próximo año es:
___Bajo ___Moderado ___Alto ___Muy Alto ___Extremo ___No se

17. Piense un momento en la ubicación de su casa. ¿Qué tan satisfecho está usted con ello, como un lugar para vivir? En una escala de 1 a 5, donde 1 significa muy insatisfecho, 3 ni descontentado ni satisfecho, y 5 significa: muy satisfecho. (Por favor encierre en un circulo la opción escogida)

(Muy insatisfecho) 1 2 **3** 4 5 (Muy satisfecho)

18. ¿Aceptaría usted una localización con altos riesgos de inundaciones con tal de que su casa está más cerca de recreaciones NATURALES (como vistas panorámicas, recreación al aire libre, etc.)?
__Sí __No

19. ¿Aceptaría usted una localización con altos riesgos de inundaciones con tal de que su casa está más cerca de centros SOCIALES (como un viaje corto al trabajo, vecinos amistosos, proximidad a escuelas u otras instalaciones públicas, etc.)?
__Sí __No

20. ¿Está usted de acuerdo o en desacuerdo con la siguiente frase?
a. Los propietarios tienen la responsabilidad de proteger sus casas de las inundaciones.
_____Fuertemente en desacuerdo _____En desacuerdo _____No opino
_____Estoy de acuerdo _____ Completamente de acuerdo

b. Las agencias del gobierno tienen la responsabilidad de proteger a la gente y las propiedades de las inundaciones.
_____Fuertemente en desacuerdo _____En desacuerdo _____No opino
_____Estoy de acuerdo _____ Completamente de acuerdo

21. ¿Vive usted en un área plana propensa a inundaciones?
___No
____Sí (____ Vivo en el área de inundaciones cada 100 años;
____Vivo en el área de inundaciones cada 500 años ;
___No se)
____No sé

22. Which ONE of the following best describes your current home? (Please check ONE)
❑ Single family home ❑ Mobile home ❑ Apartment
❑ Condominium ❑ Other (Please describe):_____

23. Do you own your current home? ❑ No ❑ Yes

24. In what year were you born?_____Year

25. **What is your sex?** ❑ Female ❑Male

26. How many people *12 years old or younger* live in your household?
❑ None ❑ One ❑ Two ❑ Three ❑ More than three

27. How many *pets* live in your household?
❑ None ❑ One ❑ Two ❑ Three ❑ More than three

28. What is your employment status?
❑ Employed, full-time ❑ Employed, Part-time ❑ Unemployed/inactive
❑ Retired ❑ Student ❑ Other (please specify):_____

29. **What is the highest grade or level of education you have completed?** (Please circle only one number)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Elementary Middle School High School College/Tech Graduate School

30. What racial or ethnic category best describes your ethnicity? (Please check one)
❑ White (not of Hispanic origin) ❑ Hispanic/Mexican-American/Latino
❑ African-American (not of Hispanic origin) ❑ Other. Specify _____

31. Your household income in 2006:
❑Less than $20,000 ❑ $20,000 - $39,999 ❑ $40,000 - $59,999
❑ $60,000 - $79,999 ❑ $80,000 – $99, 999 ❑ More than $100,000

32. Please provide any comments that you would like to make:

_____

_____

Please contact me if you are interested in receiving additional information on this study.

Elaine He
512-245-8642
Xh1003@txstate.edu
ELA 139
Department of Geography
Texas State University-San Marcos
601 University Dr.
San Marcos, TX 78666

Thank you for participating in the survey!
Please complete and return questionnaire
before November 10 ***to be eligible for the $100 prize!***
will be distributed later of this year!

22. ¿Cuál de las siguientes líneas describe mejor su casa actual? (Por favor marque UNA)
___Casa regular de Familia ___¿Casa móvil ___Apartamento
___Condominio ____ Otro (Por favor describa): _____

23. ¿Es dueño de su casa actual? __Sí __No

24. ¿En que año nació usted? Año _____

25. ¿Cuál es su sexo? ___Femenino ___ Masculino

26. ¿Cuánta gente de 12 años o menor, vive en su casa?
___Ninguno ___Uno ___Dos ___Tres ___Más de tres

27. ¿Cuántos animales domésticos viven en su casa?
___Ninguno ___Uno ___Dos ___Tres ___Más de tres

28. ¿Cuál es su estado de empleo?
___Empleado, de jornada completa ___Empleado, de Media jornada ___Desempleado/inactivo
___Jubilado ___Estudiante ___Otro (por favor especifique): _____

29. ¿Cuál es el grado más alto o el nivel de educación que usted ha completado? (Por favor escoja sólo un número)

1 2 3 4 5 6 (primaria) 7 8 9 10 11 12 (secundaria/prepa) 13 14 15 16 (licenciatura)

17 18 (maestría) 19 20 21 22 (doctor)

30. ¿Qué categoría racial o étnica describe mejor su naturaleza étnica? (Por favor elija uno)
___Blanco (no de origen hispano) ___Hispano/Mexicano- Americano/ Latino?
___Afroamericano (no de origen hispano) ___Otro. Especifique _____

31. Sus ingresos del hogar en el 2006:
___Menos de 20,000 dólares ___20,000 - 39,999 dólares ___40,000 - 59,999 dólares
___60,000 - 79,999 dólares ___80,000 – 99.999 dólares ___Más de 100,000 dólares

Por favor, si usted está interesado en recibir información adicional sobre este estudio, póngase en contacto conmigo.

Elaine He
512-245-8642
Xh1003@txstate.edu
ELA 139
Department of Geography
Texas State University-San Marcos
601 University Dr.
San Marcos, TX 78666

¡Gracias por su participación!
¡Por favor complete y devuelva el cuestionario antes del **10 de noviembre** para quedar elegible para el premio de **100 dólares!**

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VITA

Xueqin (Elaine) He was born in Xihe, Gansu province, P. R. China, the first child of Yonggang He and Linghuo Wang. Xueqin (Elaine) graduated from the No. 1 middle school of Xihe, Gansu in 1990, and then entered Lixian Normal School to be trained as a teacher for elementary school. She attended Northwest Normal University and received her Bachelor's degree of Science in Geography Education in July 1998. During the following three years, Xueqin (Elaine) studied at South China Sea Institute of Oceanology (SCSIO), Chinese Academy of Sciences (CAS), and obtained her Master's degree in Environmental Sciences. From August 2001 to July 2003, Xueqin (Elaine) was employed as a lecturer and research assistant in College of Marine Science and Engineering at Tianjin University of Science & Technology. In August 2003, Xueqin (Elaine) entered the Graduate College of Texas State University-San Marcos, where she conducted the research for her Ph.D. degree. Xueqin (Elaine)'s research interests focus on the interaction between human and natural environment with an emphasis on environmental perception, emergency response, risk communication, and hazardous zone residential location analysis. Her doctoral research focused on analysis of residential satisfaction among floodplain residents in urban area.

Permanent Address:

42-421 Ganjiaxiang, Chengguan District

Lanzhou, Gansu Province

P.R. China 730000

This dissertation was typed by Xueqin (Elaine) He.