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Role Of Community Social Capital For Acute Food Security Following An Extreme Weather Event

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ROLE OF COMMUNITY SOCIAL CAPITAL FOR ACUTE FOOD SECURITY FOLLOWING AN EXTREME WEATHER EVENT

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ABSTRACT

Worsening climate changes effects are predicted to increase the severity and frequency of extreme weather events (EWE), which can disrupt food systems, from the local to global level, and compromise community food security. In the rural U.S., food insecurity, poverty, low economic growth, and population loss are prevalent, and rural communities often lack the physical capital to bolster community resiliency to climate change adaptation. In 2011, Tropical Storm Irene (TS Irene) in Vermont was the most damaging EWE the state's history. Severely damaged roads, infrastructure, homes, and land, rendered many rural towns isolated for up to several days. The levels and types of social capital (bridging and/or bonding) affect social cohesion, which in turn influences how the community responds to an EWE. Rural Vermont communities isolated by TS Irene had to respond to a disruption of basic needs, including food security, without the ability to depend on outside resources. We investigate how social capital influenced these community responses to TS Irene, and how the community actions affected community food security. To better understand how social capital influences community response to food insecurity following an EWE, we created a social capital framework on food security. We then conducted thirty-three semi-structured interviews in three Vermont communities known to have been severely affected by TS Irene, and isolated for several days. Using grounded theory, analysis resulted in social capital having a profound influence on community responses to food security following an EWE. Additionally, the type of social capital – bonding and/or bridging – affected both how the community mitigated food insecurity in the short-term, and upheld food security in the weeks following TS Irene. We found that not only do high degrees of social capital affect community response to acute food security needs after an EWE, but also that a community's sense of place is different depending on the level of community social capital present prior to an EWE. The community response also shaped the community's perception of, and ability to creating social capital five years after the event. Previous research indicates social capital is important in both community food security and climate shock responses. We discuss the need for rural development and community social capital to build rural resilience and adaptation for future EWE. As such, we suggest that promoting the development of social capital within rural communities through community development - creation of public events, investment in public infrastructure and schools, and the promotion of locally owned and operated businesses - can build resiliency and adaptation to future EWE by promoting the growth of community social capital, both bonding and bridging, within rural communities.

Keywords: social capital, climate shocks, extreme weather events, rural development, grounded theory, community resilience, climate change adaptation, food security, food insecurity

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CHAPTER 1: INTRODUCTION

Climate change is anticipated to increase the number and intensity of extreme events in the coming decades across the globe. The warming climate will likely increase the likelihood of extreme hot days and nights stressing food production, result in more frequent heavy rainfall causing unpredictable flooding inundating communities, and exacerbate droughts straining water and other resources (National Academies of Sciences, Engineering, and Medicine, 2016). These severe impacts of extreme weather events can disrupt food systems both regionally and locally causing acute (i.e. short-term) food insecurity within communities directly affected by climate change events. While adaptation and resilience can mitigate community food insecurity through emergency response strategies, practical assessments of community adaptation primarily focus on longer term climate scenarios and/or risks already present (Smit & Wandel, 2006). When an extreme event strikes a community, food insecurity can emerge as an acute issue stemming from both pre-existing food insecurity and food insecurity caused by the extreme climate event. The consequences of climate change on acute food insecurity are difficult to predict, thus making community response even more difficult to assess. This has led to resilience and adaptation strategies focused on global food insecurity in relation to chronic hunger and food supplies over long-term climate trends (FAO, 2010), with less attention on acute community food insecurity. Given the potential for increasing extreme events in the coming decades, more attention directed at potential occurrences of acute food insecurity is needed to better understand adaptation and resilience during an time of unprecedented and unpredictable extreme climate change events.

These climate changes will have profound impacts on the current global population of more than 7 billion people (World Bank Group, 2016), and potentially exacerbate food insecurities for and existing 793 million people who are food insecure (FAO, 2015). Food security is a multi-dimensional issue affecting every country. Many tactics and strategies in agriculture, health, education, and economics are used to lowering the rates of food insecurity at the global, regional, country, and local level (Committee on World Food Security, 2012; FAO, 2013). Because food insecurity is widespread, and solutions require a multitude of knowledge sources, food security is a widely-publicized topic in the media, government reports, non-governmental agencies, and many academic journals. Food security research has been approached across many disciplines: economics (Allison, et al., 2009), sociology (Antonio, 2009), government and law (Swindale & Bilinsky, 2006), climate science (Verdin, Funk, Senay, & Choularton, 2005), agricultural science (Hubert, Rosegrant, van Boekel, & Ortiz, 2010), public health and nutrition (Costello, et al., 2009), and anthropology (Mintz & Du Bois, 2002). Within and throughout disciplines are many crucial topics such as global food security, food security and climate change, national security, vulnerable populations, agricultural development, governance, food production, immigration and migration, malnutrition and overnutrition, economic theory, and socio-economic factors. While not exhaustive, this list displays the wide range of research conducted on food security. The fact that nearly one in eight people across the globe are food insecure, and exponential population growth is expected to reach 8.1 billion by 2025 (Mirkin, 2014; FAO, 2015) makes food security a deservedly extensively researched topic. To contribute to this breadth of understanding, this research focuses on food security in rural U.S. communities, and how social capital

contributes to community resilience to climate change adaptation, and influences the responses to acute food insecurity after an extreme weather event. To the extent of the literature review below, as it relates to climate change, social capital, and food security, the resiliency of rural U.S. communities is an area not yet been thoroughly researched.

CHAPTER 2: BACKGROUND

2.1 Climate Change and Extreme Weather Events

Climate change is a globally accepted phenomenon that is projected to affect virtually every region in the world (IPCC Core Writing Team; Pachauri, R.K.; Meyer, L.A. (eds.), 2014). Even if the most plausible and effective climate change mitigation strategies were deployed tomorrow, the effect of climate change, including an increase of extreme weather events (e.g. heat waves, droughts, floods, excessive precipitation), are expected to continue for many years into decades (IPCC Core Writing Team; Pachauri, R.K.; Meyer, L.A. (eds.), 2014, p. 151). The Intergovernmental Panel on Climate Change (IPCC) defines an EWE as a rare weather occurrence in a region and/or during an unexpected time of year (e.g. inland hurricane, out of season heat wave, excessive precipitation). It might be difficult as to what constitutes classifying a weather event as "rare". However, the National Center for Environmental Information defines weather events rare when falling into the 10th or 90th percentile probability of occurrence (NOAA, 2017). When a pattern of extreme weather events trends over a period within the same observed geographical region, it is then classified as an extreme climate event (ECE) (e.g. drought or heavy rainfall over an entire season) (IPCC, 2007). The U.S. Environmental Protection Agency uses the term abrupt climate change synonymous with ECE, and further describes these events as a change in the climate system with rapid, widespread effects (U.S. EPA , 2016). For consistency and clarity, we will be using the term extreme weather events (EWE) to indicate weather events within a region not normally expected to occur. Evidence indicates that more frequent and intense EWE

combined with increasing irregularities in seasonal rainfall patterns (including flooding) are currently impacting not only food production, but also food distribution infrastructure, incidences of food emergencies, community livelihood assets, and human health in both rural and urban areas (FAO, 2010; Wheeler & von Braun, 2013; Brown, et al., 2015).

2.2 Extreme Weather Events in the northeast U.S.

As a geographical area, the U.S. is not exempt from incurring the disturbances of EWE. The IPCC Climate Change Summary for Policymakers has identified key risks caused by climate change in North America (2014). Two of these risks are extreme precipitation and cyclones, each presenting near term risks. In the Northeast (NE), winters are predicted to be significantly shortened with fewer cold days, thus resulting in more precipitation falling as rain instead of snow, and an increased frequency of heavy downpours of precipitation. The NE region risks earlier peak river flow making flooding more unpredictable. Increased cyclone intensity and lengthened cyclone seasons will increase the risk for extreme flooding events (Karl, Melillo, & Peterson, 2009).

In August of 2011, Tropical Storm Irene (TS Irene) striking Vermont, was classified as an EWE due to the rarity of such a storm in the region, and the subsequent massive flooding not expected that time of year. TS Irene caused the most amount of damage in state history (Vermont Public Radio , 2013), and the resulting flooding from excess rainfall was the worst the state has seen since 1927. Record flood levels were recorded in over half of the flow sites where a 1 in 100 chance was estimated of previous

records being broken (also known as a 100-year flood) (NOAA, 2017; U.S. Department of the Interior: U.S. Geological Survey , 2014). Since occurrences of food insecurity are likely to spike during and after an EWE, the event has great potential to effect food availability, food accessibility, food utilization, and food stability (FAO, 2008). By researching such an EWE, we can bring the underpinnings of food insecurity into the open.

2.3 Global and U.S. Food Security

Much of the current food security research, and strategic solution implementations, focuses on low-income nations, and for good reason; chronic food insecurity in many of these countries is a widespread issue. Per the Food and Agriculture Organization's Low-Income Food-Deficit Countries list for 2015, all but five of the 54 most food insecure countries are in Africa and Asia. Fortunately, the 2015 Global Food Security Index (GFSI) reports that 85% of the countries saw their food insecurity score fall (i.e. the country's food security improved) since 2014. Despite rising global populations, the current estimates of 793 million food insecure people in the globe is 221 million lower than it was in 1990-92, with most of the decrease measured in Asia, along with significant progress made in sub-Saharan Africa (FAO, 2015; FAO, 2010). These are remarkable achievements, but the focus on chronic food insecurity in the developing world overlooks the fact that food insecurity remains an issue in high-income countries as well. The GFSI reports than in 2015, even the more affluent Western Europe countries "experienced a slight decline in their food security" (Economist Intelligence Unit Limited, 2016). Understanding the reasons for declined food security in wealthier nations

is beyond the scope of this study. However, as climate change displaces people, increased migration to economically rich nations are expected to increase (Rafael, 2007), making migration destinations more vulnerable to food insecurity during EWE. This is one example of how EWE can raise acute food security issues within the most food secure nations.

There is a marked difference between food security in the U.S. and food security in low-income countries. The GFSI ranks the U.S. as the most food secure country in the world (Economist Intelligence Unit Limited, 2016). In the U.S., there are 4,000 kilocalories available per capita, per day, which is double what the USDA recommends for a healthy diet (USDA Center for Nutrition Policy and Promotion, 2014). Having twice the necessary calories in a country does not eliminate food insecurity however since physical availability is just one component of food security; an estimated 12.7% of U.S. households are food insecure during some time of the year (USDA ERS, 2016). The level of chronic food insecurity in the U.S. has risen since 2000, and nearly two-thirds of food insecure households currently rely on government food assistance programs for their food security (USDA , 2014). Unpacking the myriad of factors contributing to chronic food insecurity in the U.S. is beyond the scope of this study; however, understanding how acute instances of food insecurity may be related to longer-term and chronic food insecurity is an important component of this work. We distinguish acute food insecurity as times and places where communities rapidly lose access to sufficient food for normal life, and we consider acute food insecurity as a pre-condition to chronic food insecurity.

Given the potential for increasing EWE, and the ways in which such events can distribute food systems and food security, it is critical to explore ways in which EWE

influence food security across communities and potential strategies that may mitigate short-term (acute) food insecurities. Researching connections between acute food insecurity and climate change in the U.S. provides insight on how to prepare for the effects climate change, and the affect resilience can have on food security. In the U.S., it is necessary to continue to understand both chronic and potential acute food insecurity to enable disaster preparedness for rural U.S. communities' resilience to the adverse effects of climate change brought on by EWE. This work contributes to this effort by exploring multiple communities and their responses to an EWE and the implications of how social capital within and surrounding the communities were related to acute food security outcomes.

2.4 Measuring and Defining Community and Food Security

This research explores the relationship of community resilience and adaptation to EWE and how social connections can mitigate sudden shocks to local and regional food systems causing sudden food security vulnerabilities to surface. Thus, it is necessary to establish a baseline understanding of what makes a "community". U.S. residents' ideas of community - a term with debatable context elusive to measurement and definition (Marshall, 1998) – has generational differences over the last several decades (Putnam, 2000; Block, 2008). People born before 1946 were twice as likely to consider neighbors, church, local newspapers, the local community, and groups and organizations as part of their community as people born after 1964. The community categories of "family", "friends", and "co-workers" transcend generational differences and are the most cited

responses to a person's sense of belonging (Putnam, 2000). All of the above community groups are connected through innate societal ideas and structures such as integration, status, membership, hierarchy, symbols, norms, identification, and groups of families, organizations (e.g. religious, business, non-profit, etc....), and local communities (i.e. those connected by way of governance and/or geography) (Nisbet, 2010; Putnam, 2000). These ideas and structures of community groups form based on something the participants have in common (Marshall, 1998), which creates social cohesion operating on implicit reciprocity driven by trust (Putnam, 2000). For the purposes of the study, **community is broadly defined as the reciprocity and solidarity formed through the shared ideas and values constituting the basis of family, organizations, groups, towns, governments, and locations.**

Despite the importance of community for its influence on individual people and households, the USDA recognizes that no universally accepted definition of community food security currently exists, and the standard household-level measurement does not capture a sense of community food security. Instead, the USDA defines food security as "access by all people at all times to enough food for an active, healthy life" (USDA, 2015). Food insecurity is measured as a household-level economic and social condition of limited or uncertain access to adequate food (USDA, 2015). Upholding food security for "all people" requires local and regional coordination and cooperation driven by social norms and trust. Otherwise community food systems would be more individualistic. Because the U.S. has a highly-interconnected food system providing the means of food security, we view food security at the community level as important as household and individual level assessments.

There are four key food security measurements, also known as "pillars", that are widely recognized to uphold food security. Food security is measured by availability, access, and utilization (Barrett, 2010) and affected by the fourth pillar of food stability - all of which are required to sustain food security (Berry, Dernini, Burlingame, & Meybeck, 2015). We can think of the pillars a metaphor for building a house; you can lay rock solid foundation (food stability), but without good building materials (food access, availability, utilization), the house will not provide quality shelter, and vice-versa.

For the purposes of this study, stability of food security is a critical aspect of the focus on EWE. Food stability underlines the effectiveness of the other three pillars because both the community food security needs, and the known and unknown external factors affecting community food security may change over time. A stable food community reduces the adverse effects to access, availability, and utilization while working toward meeting the food needs of each community member. If a community lacks strong food stability, that community is at increased risk of community food insecurity over time (Napoli, 2011). With each unfavorable external incident, the pillars of access, availability, and utilization are further weakened unless solid food stability is in place to act as a safety net. While the U.S. government has used these three pillars to measure food insecurity since 1995 (USDA, 2017) there have been criticisms of the measurement tool as static and quantitative (Webb, et al., 2006; Barrett, 2010). Webb et al. makes clear that future research should collect data on the impacts of short-term shocks including climate shocks, and questions if survey designs aimed at measuring chronic food insecurity captures the extent of acute food insecurity. This study aims to explore some of these key issues.

To assess these acute changes and expand the exploration of food security studies beyond individual households, we propose to define community food security as a prevention-oriented concept that supports sustainable, community based strategies, improves the access of low-income households to nutritious food supplies, and increases community self-reliance in providing their own needs. Community food security is a comprehensive response to local food, farm, and nutrition needs (USDA ERS, 2015). The USDA lists "social cohesion" as one of the main issues concerning community food security. The USDA defines social cohesion as "a property of *social groups* describing the strength of participants' *commitment to other group members* and to the *group as a whole*" (USDA, 2015). The USDA depiction of food insecurity includes social conditions; therefore, community food security is a comprehensive response to community self-reliance. The above definition of social cohesion is easily interpreted as "social capital", which is defined more extensively in the social capital section below. It is not clear if the USDA is recognizing social capital using the institution's language, or if the USDA is using a guiding framework to analyze the social conditions contributing to food security. Despite not having a standard to measure community food security, it is clear the USDA recognizes social capital as a defining characteristic of food security and food insecurity. It is critical to examine food insecurity at the community level as communities may have greater power through cooperation (or lack thereof), more resources to deploy, and better ability to adapt than a lone individual or household. Using a USDA based definition of food security - "all people at all times" and "social cohesion" allows research to investigate beyond a collection of individuals and households and look

at larger groups forming communities (i.e. towns, organizations, institutions, etc....) deal with acute food security issues.

2.5 Rural Food Insecurity

The focus of this work is in a rural region of Vermont. Rural food insecurity is an important focus of study because evidence suggests that globally, food insecurity is predominately concentrated in rural areas (FAO, 2015). Poverty is well identified as a main cause of food insecurity and 78% of the world's poor live in rural areas (FAO, 2015; American Dietary Association, 2006). U.S. rural households have the highest rates of food insecurity, which at 17% is 4.3% higher than the national average (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015). Almost 20% of the U.S. population lives in rural areas, and of the top 10% of the most food insecure counties in the U.S., 54% are rural (Gundersen, Satoh, Dewey, Kato, & Engelhard, 2015; U.S. Census Bureau, 2015).

Feeding America is the largest U.S. based non-profit network of food banks serving over forty-six million people through 200 food banks across the country (Feeding America, 2017). The organization recognizes there are several unique challenges to rural food insecurity, including high rates of poverty and high unemployment rates, yet there are no programs to specifically address rural food insecurity factors. A possible reason for such minimal attention toward food security in the rural U.S. is that population growth rates in rural areas have been lower than growth rates in urban areas, and economic growth and job opportunities may be dwindling. The decline in rural population growth rates have been falling since the 1990's and total rural population has seen a net population loss since 2006 (USDA ERS , 2015). These potential conditions

may be confounding factors for rural communities to be resilient to climate changes and potential EWE. Rural areas often lack sufficient infrastructure to aid in food producers' adaptation to climate change (Below, et al., 2012). The U.S. government has long continued to build rural infrastructure supporting local and regional food systems (USDA, 2015). Without secure roads, bridges, schools, internet access, and community facilities, rural food systems and community livelihoods are left vulnerable to the undermining of food security. Examples can include low food access from traveling far distances to food resources; food being less available due to farmers' lack of local viable markets; food can be underutilized without widespread information and communication via the internet; and food stability is compromised when storage facilities are ineffective or absent from rural communities. Understanding the issues that affect rural populations' food security is a pressing need when considering the high rates of rural food insecurity, the growing migration from rural to urban areas, and the anticipated effects of climate change.

2.6 Food Security in Vermont

In Vermont, the focus of this study 11.9% of households are considered food insecure, below the national average of 12.7% (USDA ERS, 2016; Gundersen, Dewey, Crumbaugh, Kato, & Engelhard, 2017). Even with governmental and non-governmental safety nets (SNAP, food pantries/banks), the Vermont Food Bank serves over 153,000 people a year (Vermont Foodbank, 2016), a large number in a state with just over 624,000 people (U.S. Census, 2016) . When considering the number of people using the state's food bank network within the lowest populated state in the U.S., and most of the

state classified as rural, there exists significant food insecurity in the state of Vermont. Like the USDA, state data on county level food insecurity does not indicate the extent to which communities are food insecure. TS Irene was a EWE causing massive flooding in rural Vermont leaving exposed the mechanisms of food insecurity. This research focuses on TS Irene in Vermont to better understand community response to rural food insecurity before, during and after a EWE.

CHAPTER 3: LITERATURE REVIEW

3.1 Definitions of Social Capital

In recent years, social capital is the most studied concept in the social sciences (Fragkandreas, 2012). Sociologists and other researchers have conceptualized many definitions of social capital, with no unanimous version prevailing as the one "go to" anchor for a social capital research study. In his seminal book on social capital, Putnam (2000, p. 19) traced the evolution of the term social capital only to discover it had been reinvented at least six times in the twentieth century. The constant Putnam found is that social capital refers to the connections among individuals who join groups or form groups with other individuals - the social networks, trust, and reciprocity that arise from these groups comprises a concept of community social capital. This research study uses a combination of prominent working definitions (including Putnam's above) of social capital to serve as a framework guiding data collection and analysis. Coleman (1988) examined social capital as existing in the relations among persons to facilitate action. Woolcock and Narayan (2000) define social capital as the "norms and networks that enable people to act collectively". Ostrom (2000) summarizes social capital as the "shared knowledge, understandings, norms, rules, and expectations about patterns of interactions that groups of individuals bring to a recurrent activity". Flora and Flora (2013, p. 11) see social capital involving mutual trust, reciprocity, groups, collective identity, working together, and a sense of a shared future. The needs of community food security require social cohesion thus connecting contemporary social capital theory with the main U.S. food security research. This study uses a summarization of social capital to

define **community social capital as: the generalized trust, reciprocity, common rules, norms, and sanctions/actions motivated by groups with a shared vision of the future, and the present and future needs of those groups within a given community**.

3.2 Social Capital and Climate Change

In the last few decades a "strong sense of community" has been researched and analyzed by social sciences and governments in terms of civic culture and engagement, community capacity building, and social capital (Butcher, 2006; Paxton, 1999; Ostrom E. , 2000; Grootaert & van Bastelaer, 2001; Putnam, 2000; Portes, 1998). Social capital is what builds a community, and a strong social capital presence is the best indicator of community action (Agnitsch, Flora, & Ryan, 2006). Social capital is necessary to executing sustainable and effective actions that build resilience and engage adaptation strategies to climate change (Noblet, Guillemot, & Chouinard, 2016; Wolf, Adger, Lorenzoni, Abrahamson, & Raine, 2010; Adger, 2003; Aldrich & Meyer, 2015; Aldrich, 2017; Clay, Colburn, & Seara, 2016). If there is a lack of trust among the community affected by climate change, it could render the effects of the adaptation inoperative - the consequences from an EWE might continue to worsen levels of food insecurity during and after a climate event. Merely identifying community needs from adverse climate change effects is not enough to enact solutions unless a degree of trust between groups and actors within the community is undertaken. In other words, it is not proxy to mitigate community food insecurity without reciprocity among the participants. If local governments and community leaders include principle actors and group representatives that know and trust one another, this is an investment in social capital. This investment

pays dividends when climate shocks damage a community and the operationalizing of a newly formed strategy is effective at utilizing community resilience (Aldrich, 2017).

The existence of social capital is not enough. Unlike physical capitals, social capital must be consistently used to grow, and kept active to work for the benefit of the community (Putnam, 2000). The effectiveness of a disaster response is more dependent upon the community understanding of common rules outlined in social norms than of physical forms of capital to meet community needs (Aldrich, 2012). When common actions are based on social norms, these norms promote (or restrict) adaptation actions, including those of local, state, and federal governments. This is seen in the use of university and other public extension programs that often use sociology help build social cohesion in U.S. rural communities (Castle, 2009). These extension services also help build rural community resilience (Hunt, Vanclay, Birch, Coutts, & Flittner, 2011). Public institutions that traditionally look at efficiency and innovation now look beyond resource management and production factors, and place more focus on social capital to help formalize the idea that social capital is an essential component to community resilience and adaptation.

Social capital theory posits community individuals, groups, and organizations are required to successfully implement a plan of action that mitigates food insecurity caused or worsened by climate change. Rural Vermont communities needing to identify better strategies to augment food security and mitigate food insecurity during a future EWE can look toward social capital. Community resilience, adaptation, and emergency management plans require a combination of resources, money, facilities, people (both citizens and government), willingness (culture), and an understanding of the community

layout (trust and reciprocity). It quite possible when an acute EWE strikes, the need to reorganization state, town, non-governmental and private organization roles and how they execute that role becomes apparent.

3.3 Climate Change, Food Security, and Social Capital

Global climate change and food security is extensively researched by national and international government agencies, with heavy focus on the developing world, and these reports are easily accessible online through the IPCC, USDA, FAO, and WFP. World food security and climate change is also studied extensively in low-income nations (Wheeler & von Braun, 2013). Food security in the U.S. is well researched in terms of rural development (USDA Rural Development, 2016), sustainable agriculture production (Hanson, Hendrickson, & Archer, 2008), children's and adult health (Nanney, Johnson, Elliott, & Haire-Joshu, 2007), and economic growth (Bonanno & Goetz, 2012). Within the context of climate change, there is a real need to investigate climate change decision making outside of the material, physical, economic, and quantifiable realm (Adger, Barnett, Chapin III, & Ellemor, 2011), and to examine the full breadth and depth how social capital can increase adaptability and resilience to climate change (Pelling & High, 2005). In the U.S., food insecurity is not as much of an issue of quantity and infrastructure as it is about community access and coordination (Flora & Flora, 2013; Morton & Blanchard, 2007).

Communities exist because of human interaction and society grows because interactions lessen social exclusion. Broadly defined, social capital consists of valued social relations between people (Ritzer, 2011, p. 533). The value of these social relations,

the social capital, is embedded in the definition of community as observed through the reciprocity and solidarity created by shared ideas serving as the basis of forming groups - the collection of which we consider a community. Without social capital, the other capitals - natural, cultural, human, political, financial, and built, of which climate change resilience to food security adaptation is focused on, cannot be fully developed and employed. Social capital is the social cohesion necessary for community adaptation and resilience to take effect (Grootaert & van Bastelaer, 2001; Adger, 2003; Flora & Flora, 2013; Ostrom E. , 2000). Putting this concept in the context of food security; if food stability, as a foundation, upholds food access, availability, utilization, and these are the food security building materials, then social capital is the "glue" holding the four food security pillars in place. Community food security, providing food for "all people at all times" through coordination and cooperation can breakdown the pillars of food security if the social norms are not defined and trust between groups is weak. The U.S. government's Feed the Future initiative, a program to alleviate hunger and promote food security, recognizes that a strong sense of community is the number one key to a successful food security program (Hogue & Baquet, 2016).

Connecting community social capital and climate change at first glance could be considered a mismatch of scales. Climate change is an environmental issue with far reaching effects into economies, political states, cultures, societies, and globalization at large. Over the last thirty or so years, governments and non-governmental organizations have mounted a stronger front to curb global warming through climate change mitigation strategies at industrial, national, and global scales (United Nations, 2014). Though global scales appear too colossal for community social capital analysis, social capital continues

to be a key component to the bigger picture (Aldrich, 2017). Defining community aids this pairing of social capital and climate change. Within a community exists people who form sub-communities sharing a common history (i.e. family), social (i.e. clubs), economy (i.e. town), political interests (i.e. political party), belief system (i.e. religion), and joint ownership and professional relations (i.e. industries). Social capital applies to all scales of community from the individual household to global society. In rural towns are households, farms, neighborhood groups, public and private clubs and organizations, businesses, and town governments, to name a few. Like climate change, food insecurity is a global problem and requires collective action for long-term solutions. Ostrom (2010) purports that though collective action is needed to solve a seriously large problem such as global warming, a community's knowledge and connection with one another will prompt problem solving actions without top-down enforcement. This type of collective action was observed after Hurricane Sandy where individual and group independence did not inhibit cooperation as social bonds became the key to recovery (Clay, Colburn, & Seara, 2016). To study food insecurity within a community, and how U.S. rural communities may, or may not be preparing for climate change effects, investigating groups who constitute a given community, and the social capital, as the trust, reciprocity, and norms between these groups, is the right scale rural towns in both the near-term future.

The social capital phenomenon - community levels of trust, reciprocity, and social norms – is distinct from other theories of climate change adaptation (Adger, 2003). Research depicting the relationship between social capital and the ability to adapt to climate change found those who spent more time with neighbors were willing to sacrifice for the betterment of the environment, while those who spent more time with only family

members were less likely to sacrifice for the environment (Macias & Williams, 2016). The significance is with those having a pro-environmental attitude are more likely to recognize climate change, which has a profound influence on community-level dynamic behaviors. The social capital of the community influenced the outlook on community resilience, and community-level interaction and place-based social organization could be just as important as product based environmental adaptations. For example, Patel (2013) researched financial capital as the means to the New Green Revolution (NGR) - a plan to extend the Green Revolution into the rural areas of the world as way to produce more food in the face of negative climate change affects. Patel's research predicts land grabs, patents on life, and nutritionism are expected to increase if a NGR expands - solving one problem while increasing others and adversely affecting food security at the lower levels of society. Using the economy to increase agricultural technology may be attractive to policy makers, but it ignores other crucial components (social capital) to climate change and food security resilience. Tompkins and Adger (2005) purport rather than continuing to approach climate change in a dichotomous way - mitigation for governments and industries, adaptation for everyone else - we need to consider the overlap between groups to make use the spectrum of options available. "Response capacity is driven by technology and societal factors in the form of individual or group behavior" (Tompkins & Adger, 2005). It is apparent that societal factors, such as social capital, are necessary to solve large problems from climate change to food insecurity.

Social capital behaves differently than other capitals. Unlike physical capitals (i.e. a finite resource as natural capital), social capital does not depreciate with use, but rather with disuse and does not have future discounting trade-off factors. Arrow (2000) states

that social capital should not be studied in the way we might study other forms of capital such as built or natural capital. Indeed, if physical and regulatory infrastructures are sufficient for adaptation, and can alone minimize effects of climate change, then it is not necessary to resonate physical capitals with social norms. The consideration of social capital's multiple factors is key to creating a sustainable solution to food insecurity in the wake of climate change events. Social capital allows people to utilize mechanisms for collective resolution, smooth community advancement, and widening awareness of our interconnectedness - problems are solved in just and democratic ways more easily with strong social capital (Putnam, 2000, pp. 288-290).

3.4 Bonding and Bridging Social Capital and the "Dark Side" of Social Capital

Social capital is considered important to a healthy, stable community by bringing other forms of capital together and making more available their use. In the context of food security, a community cannot be considered healthy and stable if a significant portion of the population is food insecure, or would easily become food insecure from an event such as climate shocks. There are two forms of social capital core community elements can be placed - "bridging" and "bonding" social capital.

Bonding social capital is common with family, kinship, church and religious organizations, clubs, political parties, investments (financial and otherwise), to name a easily observed examples. Bonding social capital fosters strong trust and reciprocity, and lessens transaction costs by streamlining access to resources though homogeneity - demographic, ideological, or otherwise. It is the connections among groups and

individuals with similar backgrounds that act as the driver for reciprocity within groups, and mobilizing solidarity within a community (Flora & Flora, 2013; Putnam, 2000). Bonding social capital is especially important with low income and socially excluded groups to "get by" through social support, and when the state provides social security but cannot effectively distribute resources to all those in need (Burkley, Brown, Holben, Shubrook, & Schwartz, 2011; Briggs, 1998). Bonding social capital is not always benevolent. The "dark side" of social capital arises when overly strong bonding social capital promotes out-group exclusion and causes individual and/or small group isolation. Higher degrees of bonding social capital can restrict individual freedom and become exclusive barriers to newcomers and outsiders thus restricting access to resources. Excessive bonding social capital can be balanced with greater bridging social capital.

Bridging social capital, also known as network capital, are the ties to those not within the inner circles formed by bonding social capital. . Bridging social capital is commonly found with economic and other external ties, in legal and formal institutions, and can differ greatly between regional and cultural differences. Bridging social capital connects diverse groups within and outside the community at the household, neighborhood, government and non-governmental, and township level, and can act as a counter to out-group antagonism (Flora & Flora, 2013; Putnam, 2000). Bridging social capital is important in the case of dynamic mobile communities, the managing of collective resources, and in the absence of state presence. In a rural community, bridging is important if a town has no food pantry, lacks businesses and services, has weak intra-community involvement, the local governments are sparsely operating, and/or local governments lack the ability to allocate scarce resources during a disaster. Migrant

groups, or highly seasonal communities, such as migrant farm workers and second home communities, are especially reliant on bridging social capital to connect with year-round, long-term community members for intra-group access and a stronger sense of social cohesion. In times of need, such as during and after an EWE, a community uses bridging and bonding social capital to sustain food security and/or mitigate food insecurity caused or worsened by a climate shock.

There are caveats to using social capital in research. Portes (1998) discusses many of the most prominent theories of social capital presented in the writings of Putnam, Bourdieu, Loury, and Coleman to temper the ideal that social capital is a valid and reliable measurement in social science. They take issue with social capital being both cause and effect - neighborhoods, communities, towns, and even states with more affluence and education tend to have higher social capital and less crime, poverty, and other social ailments. The more social capital a community has at their disposal, the more likely that community is effectively addressing negative social issues. A high degree of social capital creates solidarity through social ties to control wayward behaviors, influence actions (or lack of action), and provide privileged access to resources. Portes concludes to best study social capital, it is necessary to study social facts in all their complexity while avoiding the tendency to attach social capital as a value system – *social capital is neutral*. To avoid this downfall, we do not assign a cause and effect direction of social capital, rather we assess community social capital as perceived by group members and connect it to observations of social norms, trust, and reciprocity that drives actions following an EWE. This avoids assigning a value system to community social capital. Social capital has a place in theory and research so long as different sources are used to

understand social capital, and the effects of social capital are recognized with equal attention to the downsides.

One such downside, called the "dark side" of social capital, was found when local political structures addressed climate change problems, but kept to an exclusive group and did not involve marginalized groups in the decision-making process (Pelling, 1998). By identifying social capital as hindrance to vulnerable households' ability to access community and government mitigation strategies, it can be said that too much social capital deepened the marginalized community's vulnerabilities. Because a top-down approach strengthened pre-existing vertical linkages, rather than promoting horizontal ties, an imbalance of bonding and bridging social capital caused out-groups to become further marginalized despite the presence of active climate change mitigation and adaptation strategies. After a devastating tsunami hit India, is was discovered that an imbalance of social capital caused aid to be distributed unevenly, leaving out many social groups (Aldrich, 2010). The "dark side" of social capital is not mutually exclusive as both bonding and bridging social capital can have negative effects. Too much bonding social capital and there is greater potential for extra-group exclusion; too much bridging social capital, incentives for opportunism and malfeasance can increase (Putnam, 2000). Disaster recovery differs and depends on social capital (Joshi & Aoki, 2014), which can have both positive and negative effects to be considered equally.

Bridging social capital is important for community adaptation and risk management; bonding social capital supports and sustains the families, friends, households, and small groups during a time of need. There is no one level of measured bonding and bridging social capital balance to ensure high resiliency and adaptation to

climate change. It is hard to determine how much social capital is required because the scope of the social capital necessary depends on the scale of the problem faced (Putnam, 2000, pp. 362-363). However, it is known that some combination of bridging and bonding social capital is required for community resiliency and adaptation (Aldrich & Meyer, 2015; Flora & Flora, 2013; Weil, Lee, & Shihadeh, 2012). If social capital is used for the good of the community, then intra-groups (i.e. relatives, church congregation) need to be cognizant of extra-groups (i.e. strangers, atheist non-members), and how services can be effectively distributed among those in need. The community need can inform the scale of social capital required, but allocation dictates the scope. In the case of food security and climate change, both bridging and bonding social capital are necessary to address food insecurity during and after EWE.

Keeping scope in perspective is important at both ends of the bonding and bridging social capital spectrum. Food insecurity within a household places the individual's ability to access a community resource into the realm of community food security – the household must be able to engage with the broader community (Garasky & Stewart, 2007; Burkley, Brown, Holben, Shubrook, & Schwartz, 2011). Resources allocated to a community though organized state and non-governmental distributed methods (SNAP, WIC, food pantries/banks, charity food distribution) are often shared in a more reciprocal manner (e.g. the knowledge of food resources are shared with friends, family, and neighbors) in informal settings (Morton, Bitto, Oakland, & Mary, 2008; Burkley, Brown, Holben, Shubrook, & Schwartz, 2011). It is often the case that a need for bridging social capital can be fulfilled by governments. Adger (2003) looked at several communities and researched their use of social capital in climate change

resilience. The study concluded that the state is necessary to bridge climate change intervention and planning between groups at the community level. Adaptation strategies are dependent on the ability for individuals and communities to act collectively in the face of risk. Government recognition of bridging social capital is another step to helping rural adaptation and mitigation strategies necessary to lessen the impacts of climate change on food security (Sander-Regier, McLeman, Brklacich, & Woodrow, 2009). Scope of the issue is important, from individuals within households, neighborhoods and communities, up through the local and state government, to consider when assessing the level of social capital needed to support rural food security through resilience to climate change.

3.5 Bonding and Bridging Social Capital and Climate Change

Bonding and bridging societies, as one of four categories – high bonding and high bridging, low bonding and high bridging, high bonding and low bridging, and low bonding and low bridging - are well conceived in leading social capital works (Flora & Flora, 2013, p. 128; Putnam, 2000, pp. 354-355; Woolcock & Narayan, 2000). In high bonding/high bridging social capital communities, decisions are based on the common good and civic engagement are encouraged, and both extra-group and intra-group community presence is known. In low bonding/high bridging social capital communities, attitudes are individualistic (you do your thing, I'll do mine) and decisions are based on what outsiders provide. In high bonding/low bridging social capital communities is little extra-group trust, and investments are made internally, for the benefit of the intra-group.

In low bonding/low bridging social capital communities is extreme individualism and everyone is "out for themselves". Below are examples of how an imbalance of bonding and bridging social capital can affect people during and after climate change events.

As climate change worsens it will affect the poor in low-income and wealthier countries alike (Anthony & Woodruff, 2004), but as seen after Hurricane Katrina, the risk to human health affects some individuals more than others (Adeola & Picou, 2012). It is sometimes the case that an increase in bridging social capital can help poor community members during EWE. Edi (2011) discovered how building social capital provides a strong basis for increasing resilience to the health risks of EWE. Their research indicates that increased building social capital strengthens community resilience and adaptation in response to EWE. Low bridging social capital in Chicago found that those who perceived to have low social capital, and lived in large residential apartment buildings, were more likely to die from heat extremes than those who perceived to have high levels of social capital and lived elsewhere - those socially isolated were at greater risk (Semenza, et al., 1996). Using a ground theory approach to examine the lives of 40 families following Hurricane Katrina, Hawkins and Maurer studied what types of social capital were used to survive, relocate, and rebuild during and after the EWE. Both bonding and bridging social capital was utilized, but bonding social capital was more important in the short-term, while bridging social capital appeared more necessary for long-term recovery. The above studies point out how different forms of social capital can be a strength, and a hindrance, to individuals and communities following a EWE.

3.6 Food Security and Social Capital in the U.S.

There are interesting findings concerning social capital and long-term food insecurity within U.S. communities. A food security survey in Hartford, CT (a relatively food secure state) found a positive correlation between social capital and decreased risk of hunger. Though the study did not attempt to infer causality or which promotes which, social capital and food security, the conclusion found the odds of experiencing hunger at both the household and community level are greatly reduced with positive perceptions of social capital (Martin, Rogers, Cook, & Joseph, 2004). A huge disparity between "often hungry" and "never hungry" was discovered within rural Texas residents; those with low-income, in minority groups, and reporting lower education levels were more likely to experience food insecurity. Additionally, they compared food security and social capital between rural and urban residents, and found significance in the evaluation, attitude, and access to food within rural communities and how the subjects perceived their social capital (Dean & Sharkey, 2011). Looking at food security factors - income, education attainment, single-headed households, and lack of transportation – one study found rural residents to be more likely food insecure than urban residents. However, food insecurity factors - isolation, access, attitude, and lack of perceived support (social capital) – all improved with stronger, and more available social capital (De Marco & Thorburn, 2008). Hofferth and Iceland (2011) found bonding of families in rural settings more prevalent than urban settings, but discovered urban settings to have a higher mean of social capital. They highlight a difference between bonding and bridging social capital. Kin stick together creating stronger bonds that don't always translate to better bridging social

capital, whereas social networking may lack the family ties often associated with bonding social capital.

Suggesting a reversal of roles in social capital and food security, findings on social capital, food insecurity, and resource utilization in a low-income population in Alabama indicate that experience with food insecurity is a greater predictor of knowledge development sourced from social capital (Morrow, 2013). Interestingly, the research concludes that because sub-groups share food access information, this form of food security adaptation predicts the social capital knowledge. Mammen et al. (2009) looked at USDA survey data and discovered a paradox: rural low-income families in food secure states were persistently more food insecure than families from food insecure states. Families from food insecure states had higher per capita median income and higher life satisfaction than those in food secure states. The above studies indicate three things; 1) urban and rural social capital and food security are different enough to separate as subjects of food security and social capital; 2) more research is needed to better understand the effect of social capital on rural communities; 3) we know very little about rural community social capital in relation to acute community food security issues.

A thorough review of the literature found no research or publications on the specific topic of U.S. rural food security affected by climate change, and no study indicated how social capital factors into food insecurity mitigation, adaptation strategies, and community resilience during or after an EWE in the U.S. Prior studies looking at food security and social capital focus on longer term household food insecurity using annual measurements. While these articles in this literature review add context and depth to the background and purpose of the study, we aim to fill this gap in the literature. As

such, we focus on acute food insecurity as witnessed by community members, and how social capital is connected to resilience and adaptation to food insecurity in the rural U.S.

CHAPTER 4: MOTIVE FOR RESEARCH

4.1 Introduction

It is an inevitable fact that increased climate change will bring about more frequent and intense EWE. Rural communities' vulnerabilities to food security, and existing community food insecurity issues, will worsen the underlying community resilience to adapt to food security problems as climate change worsens. Most of the strategies to deal with food insecurity and climate change in the U.S. have been top-down government issued solutions (USDA , 2015; Brown, et al., 2015), and/or bottom-up mitigation and support (USDA National Agricultural Library, 2009). Both approaches primarily rely on prescriptive strategies utilizing more quantifiable, material capitals (i.e. funds for assistance programs, climate adaptation agriculture technology, mitigation law and policy, etc.). Past research has done an incredible job helping society understand social capital in disaster responses, yet there still remains a call for more social science research into the field of climate change adaptation and resilience (Aldrich & Meyer, 2015; Weil, Lee, & Shihadeh, 2012).

The most food secure nation in the world has a significant food insecurity problem, and within U.S., every state has a significant food insecurity population. Considering times of crisis will only become more common as climate changes disrupts communities with more sever and frequent climate shocks, we assert the indispensable need for continued research on community resilience.

4.2 Researching Food Security and Social Capital

Social capital is not simply issued like financial capital through mediums such as legislative bills promoting public program funding and economic development. Governments and businesses are unable to directly provide a community with more social capital to address community food insecurity in anticipation of climate change – a fact that becomes more critical when thinking about acute food security issues caused by EWE. Contemporary thinking tends to associate climate change induced food insecurity with the worlds' low-income countries, yet there remains a significant food insecure population in the U.S., especially in rural areas. Looking at The Dust Bowl era as a powerful long-term EWE analog, we are reminded that food scarcity can, and does occur in the U.S. A review of the Dust Bowl era urged for more research on human and physical systems in the face of climate events if communities are to better inform policy and shape rural development (McLeman, Dupre, Berrange Ford, Ford, & Gajewski, 2014). Mohan's (2002) work on civil society, a space in which social capital operates in during a time of crises, affirms that including social capital is necessary for problem solving research and strong climate change event analysis. Mohan's work suggests that we cannot only look at empirical evidence, institutions, or physical forms of capital and expect to identify all the key answers to complex issues such as food security stressed by climate change. By focusing on rural U.S. communities with different categories of social capital, we can unpack some of these complexities to investigate community social capital. It is within the perceptions of those using bridging, bonding, or a combination of bridging and bonding social capital to mitigate acute community food insecurity during and after a climate shock that we find more nuanced details of how social capital

influences responses to EWE. This approach allows us to better understand the underpinnings of social capital and acute food insecurity caused or worsened by EWE.

The USDA recognizes social cohesion as an important element for addressing food insecurity issues and upholding food security. The three USDA food security pillars - availability, access, and utilization (USDA, 2015) - and the more recently recognized pillar of stability (FAO , 2008) all require the coordination of people to participate at the community level. It is true that with knowledgeable and persistent traditional methods of food procurement (foraging, seed planting, hunting, and fishing) that a single actor can be food secure without coordinating with, or depending on other people. However, examples of total self-sufficiency are exceptional, and certainly rare in the U.S. In contemporary communities, the four food security pillars require multiple people within and outside of any given community for everyone to be food secure. Social cohesion is made stronger with a combination of bridging and bonding social capital appropriate for the scale and scope of community needs.

Community bonding and bridging social capital contributes to community food security following a EWE. Bridging social capital enhances the food stability by connecting different private and government food storage, transport, and power supplies to secure the quality and longevity of food during the recovery process after a EWE. Bridging social capital also increases food access by connecting different groups of who otherwise do not usually coordinate during times of climate stability. Bonding social capital makes food more available to those within a community, especially when resources are shared intra-group. This is seen when a town provides food to their residents before making any food sources available to a neighboring town, or a church

group contacting congregation members first, thereby making food available to the church community before the public. Bonding social capital increases food utilization. This is observed within a family or tightly related group to ensure each member has specific dietary needs met. Because a community with high social capital is more likely to have intimate knowledge of each other, this community can better maximize food resources by making sure the right food gets to the right people.

The categories of social capital (low bonding/high bridging, low bonding/low bridging, high bonding/low bridging, and high bonding/high bridging) can highlight what pillars of food security are secure and stable, and what pillars are lacking in when acute community food security issues arise. By better understanding the rural community social capital before, during, and after TS Irene, and what community responses to community food security during the days after the event, the collection of perceived social capital from those who experienced an EWE, and still reside in the community today, can indicate which types of social capital are best suited to address acute food insecurity during and after an EWE.

4.3 Purpose

The purpose of this study is to better understand rural community response in the face of climate change induced climate shocks, and the types of community social capital that best support community food security, and addresses acute food insecurity caused or worsened by climate shocks. The prevalence of different combinations of bonding and bridging social capital is important at different times, and for different groups, but not

always the community at large. Social capital is a moral economy that is necessary for coping with weather extremes and other hazards and their impacts (Adger, 2003). and the effects of climate change will be felt in every country, and every region of the U.S. The aim of the research is therefore to investigate themes of social capital that emerge when rural U.S. communities are confronted by climate change, and if social capital influences community response to acute food insecurity during and after an EWE. By using a social capital lens, we can look at the significant intangible contributors to food security resilience and climate change adaptation within the U.S. for future planning and future climate change induced food insecurity. The research contributes to the social science climate change research by identifying types of social capital having effect on U.S. rural communities. This also contributes to the call for building social capital in the rural U.S. as a viable means to lessen the impact of climate change on acute food insecurity.

In addition, it is our desire to better inform policy makers, economic developers, town and state governments, community organizations, and rural businesses about strategies to using social capital as resiliency and adaptation support. We hope this investigation of social capital provides the crucial insight to prepare for the impacts of climate change disasters on community food systems. We believe this research helps Vermont, the rural U.S., rural food insecure populations, food insecure areas both within and outside of the U.S., and possibly build templates for urban social capital research.

CHAPTER 5: JOURNAL ARTICLE

Chriest, A., Niles, M.T.. (2017). Role of Community Social Capital for Acute Food Security Following an Extreme Weather Event

Abstract

The current climate change trajectory is expected to increase the frequency and intensity of extreme weather events (EWE), which have the potential to influence food security. Given this, communities with durable resiliency will have greater adaptation capacity to uphold community needs during and after EWE. A growing body of work is exploring both the role of social capital to increase resilience to climate adaptation and as an important precursor for food security. Here, we explore how varying levels of community social capital related to responses to an EWE. We focused on Tropical Storm Irene, which hit several rural Vermont towns in 2011, causing damages that isolated many communities for multiple days. This study looks at three of these severely affected communities to better understand how two types of social capital, bonding and bridging, contributed to the community resiliency to food insecurity, and how prior perceptions of social capital influenced climate adaptation following an EWE. Using grounded theory, thirty-three semi-structured interviews were conducted to gain insight into the perceptions of, and responses to rural community food insecurity during and after an EWE. The study finds that social capital does influence community response following an EWE, and the more bonding and bridging social capital a community had prior to TS Irene, the more a community displayed resiliency with a wider range of adaptation strategies. The results also show that a community's sense of place is different depending on the level of community social capital present prior to an EWE. We suggest areas for future research to investigate how investment into rural social capital can help communities build resiliency and expand adaptation. As such, we suggest that promoting the development of social capital within rural communities through community development can build resiliency and adaptation to future EWE by promoting the growth of community social capital, both bonding and bridging, within rural communities.

Introduction

Climate change is projected to affect virtually every region in the world (IPCC Core Writing Team; Pachauri, R.K.; Meyer, L.A. (eds.), 2014; NASA, 2017), though with varying impacts and uncertainties. Importantly, climate change impacts are predicted (and some suggest environmental climate change impacts have already begun (Rockstrom, et al., 2009; Barnosky, et al., 2012)) even if the most plausible and effective climate change mitigation strategies were deployed today. As climate change worsens it will especially effect the food security and community health of the poorest in low-income and high-income countries (Anthony & Woodruff, 2004; Hanjra & Qureshi, 2010), albeit with individuals and societies having different potential adaptive capacities (Smit & Wandel, Adaptation, Adaptive Capacity and Vulnerability, 2006). The effect of climate change, including an increase of extreme weather events (EWE), defined as a weather occurrence "rare or rarer than the 10^{th} or 90^{th} percentile", and "typically include floods and droughts" (NOAA, 2017) is expected to continue throughout the 21^{st} century (IPCC Core Writing Team; Pachauri, R.K.; Meyer, L.A. (eds.), 2014, p. 151). Evidence indicates that more frequent and intense EWE will impact food production, food distribution infrastructure, and incidences of food emergencies in both rural and urban areas (Brown, et al., 2015; FAO, 2010; Wheeler & von Braun, 2013). The EWE impacts create critical need to better assess how EWE influence food systems, particularly food security during and after an EWE and what factors may facilitate community resilience in the face of rising EWE risks. Here, we strive to better understand these factors through a

study focused on acute community food security and social capital within multiple communities in the rural U.S. Northeast (NE) following an EWE.

In the NE United States, it is predicted that an increase in extreme precipitation and the number/strength/intensity of hurricanes will be the two most damaging EWE risks in the future. Northeast winters are predicted to be significantly shortened resulting in more precipitation falling as rain instead of snow, and an increased frequency of heavy downpours of precipitation. Increased hurricane intensity and lengthened hurricane seasons will increase the risk and unpredictability for extreme flooding events (Karl, Melillo, & Peterson, 2009) Flooding could significantly influence food production and availability if crops and livestock are lost, and transportation routes are impassible due to damaged caused by an EWE. Food distribution centers and transport can also be damaged by flooding, or made ineffective with power outages and damaged roads (Crimmins, et al., 2016).

The prediction is that EWEs will impact food security in the coming decades across the world (Brown, et al., 2015). The FAO of the UN defines food security as occurring when "all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life". Food security is defined by four pillars including availability, access, utilization, and stability (FAO, 2017; FAO , 2008). Climate change threatens the stability of food security with impacts across all four pillars (Brown, et al., 2015). It may affect availability through its impact on crop and livestock production, influence access through distribution shifts, affect utilization because of changing nutrient levels in food, and fundamentally make all aspects of the system less stable

(Niles, Esquivel, Ahuja, & Mango, 2017). Without sufficient food stability and access, the likelihood of short-term food shortages increase as climate change may initiate struggles for food access (Schwartz & Randall, 2003). If food availability, access, utilization, and stability in U.S. regional food systems are disrupted from an EWE, the ability to have safe, nutritious food becomes challenging, and rising food prices may cause marginally food secure community members to be more vulnerable to chronic diseases and overburden health care systems (Dodge, Gowda, Hadley, & Aiello, 2013).

Such potential EWE induced future challenges to food security come on top of already existing food insecurity challenges, particularly for rural regions. In the U.S., an estimated 12.7% of U.S. households are food insecure during some time of the year (USDA ERS, 2016). U.S. rural households (20% of the U.S. population) have the highest rates of food insecurity at 17% - 4.3% higher than the national average (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015). Of the top 10% of the most food insecure counties in the U.S., 54% are rural (Gundersen, Satoh, Dewey, Kato, & Engelhard, 2015; U.S. Census Bureau, 2015). Factors associated with rural food insecurity are myriad. Many parts of the rural U.S. are considered food deserts – a significant portion of the county population lives more than one mile from a food store and/or does not have adequate income to be consistently food secure (USDA , 2009; Sharkey, 2009). Up to one out of three rural census tracks with high poverty rates have a mean distance of >10 miles to a food source (McEntee & Agyeman, 2010). Rural income rates average almost 25% less than non-rural areas, and U.S. poverty rates have remained about 3% higher than non-rural since the 1970's (USDA, 2017). Further, three out of four rural food sources are convenience stores – a food provider mostly void of affordable, healthy food options

(Liese, Weis, Pluto, Smith, & Lawson, 2007). These challenges are critical to understand as EWE present themselves in increasing intensity and frequency in the coming decades, which will present new challenges for food security beyond existing chronic issues.

Importantly, recent climate change policy research (Jones, Clark, & Tripidaki, 2012; Larson, Lauber, Kay, & Cutts, 2017; Ingold, 2017) has demonstrated that social capital – the trust, reciprocity, and relations between people - may be critical for both food security (Tibesigwa, Visser, Collinson, & Twine, 2016) and for responding to disasters (Ludin & Arbon, 2017; Hawkins & Maurer, 2009). As such, here we explore how an EWE - Tropical Storm Irene - affected rural communities' acute food security and how social capital within and beyond the communities influenced their responses. Given the potential for EWE to increase, the current prevalence of rural food insecurity, and the increasing recognition of social capital to combat potentially both topics, we investigate the perception of social capital's influence on community food security from a diverse range of rural residents who experienced the devastating effects of an EWE.

Background

Social Capital

Social capital theory posits that reciprocity, trust, and connecting of community individuals, groups, and organizations are key to implementing action that mitigates food insecurity caused or worsened by an EWE, and strengthening food security in the face of future EWE can bring together effective actions that engage adaptation strategies to climate change (Noblet, Guillemot, & Chouinard, 2016; Wolf, Adger, Lorenzoni, Abrahamson, & Raine, 2010). Low levels of social capital among those affected by

climate change can stymie adaptation and erode resilience, which could exacerbate food insecurity during and after a climate event. Social science researchers have conceptualized many definitions of social capital, with no unanimous version prevailing as the one "go to" anchor for a social capital research study. Broadly defined, social capital consists of valued social relations between people (Ritzer, 2011, p. 533). In his seminal book on social capital, Putnam (2000, p. 19) traced the evolution of the term social capital only to discover it had been reinvented at least six times in the twentieth century. One constant was that social capital refers to the connections among individuals who join or form groups with other individuals - the social networks, trust, and reciprocity that arise from these groups comprises a concept of community social capital. Here we define social capital as the existing relations among persons (Coleman J. S., 1988) to facilitate the "norms and networks that enable people to act collectively" (Woolcock & Narayan, 2000), with the "shared knowledge, understandings, norms, rules, and expectations" about group interactions (Ostrom E. , 2000), to engage other individuals and groups with mutual trust, reciprocity, collective identity, and a sense of a shared future (Flora & Flora, 2013, p. 11).

In the last few decades a "strong sense of community" has been researched by social scientists and governments related to civic engagement, community capacity building, and social capital (Butcher, 2006; Paxton, 1999; Ostrom E. , 2000; Grootaert & van Bastelaer, 2001; Putnam, 2000; Portes, 1998), and in recent years, social capital is the most studied concept in the social sciences (Fragkandreas, 2012; Engbers, Thompson, & Slaper, 2017). Social capital is what builds a community, and a strong social capital presence is the best indicator of community action (Agnitsch, Flora, & Ryan, 2006).

Without social capital, the other capitals - natural, cultural, human, political, financial, and built - cannot be fully developed, employed, or adapted. As a review of physical forms of capital suggest, climate change and adaptation resilience requires the involvement of social capital (Patel, 2013). Social capital is the social cohesion necessary for community adaptation and resilience to take effect (Grootaert & van Bastelaer, 2001; Adger, 2003; Flora & Flora, 2013; Ostrom E. , 2000). Social capital allows communities to utilize mechanisms for collective resolution, community advancement, and widening awareness of our interconnectedness – each a key consideration for creating a sustainable food security solution in the wake of EWE.

Social Capital: Bridging and Bonding

There are two forms of social capital in which core community elements can be placed - "bridging" and "bonding" social capital. Bonding social capital lessens transaction costs by streamlining access to resources though homogeneity - demographic, ideological, or otherwise. Common examples of bonding social capital are found within family and kinship, church and religion, business and investment groups, political organizations, and non-governmental organizations and clubs, to name a few. This is not to say all these groups have strong bonding social capital, rather bonding social capital is more likely formed within these groups, especially at smaller, localized scales. It is the connections among groups and individuals with similar backgrounds that act as the driver for reciprocity within groups, and mobilizing solidarity within a community (Flora & Flora, 2013; Putnam, 2000). Bonding social capital is especially important with low

income and socially excluded groups to “get by” through social support, and when the state provides social security but cannot effectively distribute resources to all those in need (Burkley, Brown, Holben, Shubrook, & Schwartz, 2011; Briggs, 1998). Bonding social capital is not always benevolent. The "dark side" of social capital arises when overly strong bonding social capital promotes out-group exclusion and causes individual and/or small group isolation. Higher degrees of bonding social capital can restrict individual freedom and become exclusive barriers to newcomers and outsiders thus restricting access to resources. Excessive bonding social capital can be balanced with bridging social capital.

Bridging social capital, also known as networking capital, are the ties to those not within the inner circle of closely related groups. Bridging social capital is commonly found with economic and other external ties, in legal and formal institutions, and can differ greatly between regional and cultural differences. Bridging social capital connects diverse groups within and outside the community at the household, neighborhood, government and non-governmental, and township level, and can act as a counter to out-group antagonism (Flora & Flora, 2013; Putnam, 2000). Bridging social capital can be important in the case of managing of collective resources, and in the absence of government presence.

Social Capital and Climate Change

Climate change influences social considerations through resource planning and management. The relationship between social capital and adaptability and resilience to

climate change has received considerable attention. Adger (2003) showed that the social capital phenomenon, as trust and social norms, is separate from other theories of climate change adaptation including those from anthropological, economic, and political science based approaches on the relative state of human ecology and geography. Social capital frames resource management that builds community resilience, even though the state may be needed to bridge climate change planning between groups at the community level (Adger, 2003). Community attitudes and perceptions also shape social capital, and are important for community-level interaction, social organization, and adaptation; groups within communities perceiving higher levels of social capital are more likely to engage in climate change mitigation and/or adaptation strategies (Macias & Williams, 2016), which is critical since adaptation requires collective action in the face of risk (Wolf, Adger, Lorenzoni, Abrahamson, & Raine, 2010). Tompkins and Adger (2005) purport rather than approaching climate change dichotomously - mitigation for governments and industries, adaptation for everyone else – research needs to consider the perception of overlap between groups to make use of the spectrum of options available since, "response capacity is driven by technology and societal factors in the form of individual or group behavior" (Tompkins & Adger, 2005). Though it is understood that increased social capital strengthens community resilience and adaptation in response to EWE (Ebi, 2011; Semenza, et al., 1996), social capital is not well integrated in U.S. disaster and climate change policy research (Hawkins & Maurer, 2009).

Food Security and Social Capital

State mitigation strategies, to some extent, do recognize social capital is necessary for community adaptation and resilience to effectively lessen the impacts of climate change on food security (Sander-Regier, McLeman, Brklacich, & Woodrow, 2009; Hogue & Baquet, 2016), and research shows food insecurity is not as much of an issue of quantity and infrastructure as it is about community access and coordination (Flora & Flora, 2013; Morton & Blanchard, 2007). This is supported by the idea that food insecurity within a community places the individual's ability to access a community resource into the realm of community food security – they must be able to engage with the broader community (Garasky & Stewart, 2007; Burkley, Brown, Holben, Shubrook, & Schwartz, 2011). For example, food resources allocated to communities though organized state and non-governmental distribution methods (e.g. SNAP, WIC, food pantries/banks, charity food distribution) are often shared in a reciprocal manner using social capital. One study showed that knowledge of available and accessible food resources, both formal and informal, are more often shared within circles of friends, family, and neighbors in informal settings (Morton, Bitto, Oakland, & Mary, 2008). Social capital and food security can work both ways as food insecurity can lead to social capital - indicating that one's experience with food insecurity is a greater predictor of the knowledge development of food resources (Morrow, 2013). Though social capital is recognized as a principle component of community food security, the effect of social capital on rural adaptation and resilience, and community food security is relatively unknown.

Study Focus and Questions

As the frequency of climate shocks increase due to climate change, rural communities, as part of climate change adaptation and resilience, will seek to ensure food security during and after an EWE. Climate change will have profound impact on the four pillars of food security (Brown, et al., 2015), and rural communities are especially vulnerable to adverse climate change effects (Adger, 2003). Because most of Vermont is considered rural, and occurrences of food insecurity are likely to spike during and after an EWE, events such as TS Irene have great potential to de-stabilize food availability, food accessibility, food utilization, and food stability (FAO, 2008). This research aims to better understand how social capital may influence the underpinnings of short-term community food insecurity following an EWE in the rural U.S.

Our aim in investigating rural social capital is to understand the dynamics of community resilience and adaptive capacity when a collection of rural individuals, households, community groups, and town governments respond to food insecurity during and after an EWE. We investigated communities, a collection of groups such as (but not limited to) households, clubs and organizations, political and religious association, geographic proximity, geopolitical boundaries, and groups of individuals who know and interact with one another on a consistent basis and consider one another a part of their community. As such, we define community social capital as the generalized trust, reciprocity, common rules, norms, and sanctions/actions motivated by groups with a shared vision of the future and the present and future needs of those groups within a given community.

The bridging/bonding framework (figure 1) allows the research to categorize perceptions of community social capital, as assessed with emerging themes in the data, and to associate the data with the community member's perception of one of the four types of bonding/bridging communities. Bridging and bonding societies, as one of four categories – high bridging and high bonding, high bridging and low bonding, low bridging and high bonding, and low bridging and low bonding - are well conceived in leading social capital works (Flora & Flora, 2013, p. 128; Putnam, 2000, pp. 354-355; Woolcock & Narayan, 2000). Drawing upon both this bridging/bonding framework and the theories of social capital we pose the critical question: How does perceived community bonding and/or bridging social capital affect community response to food insecurity issues during or after an EWE?

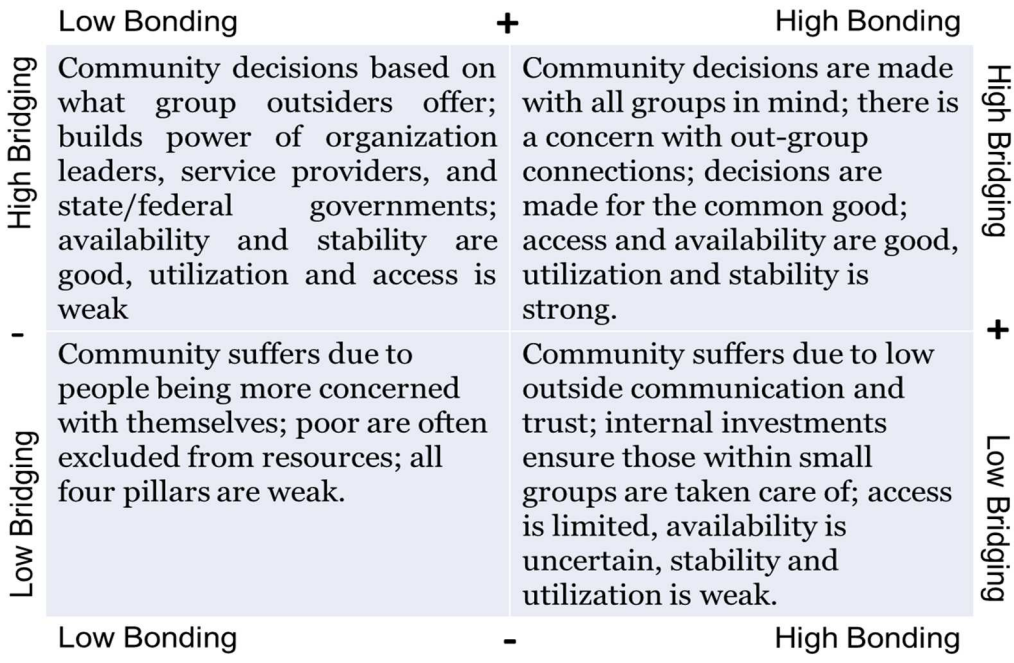

Figure 1. Conceptual Framework for Bridging/Bonding Communities. Adapted from Bowling Alone, by R.D. Putnam, 2000, New York, NY: Simon & Schuster. Adapted

from Rural Communities, by C.B. Flora, J.L. Flora, and S.P. Gasteyer, 2015. Boulder, CO: Westview P.

Methods

Study Site

Tropical Storm Irene (TS Irene), struck Vermont August 28, 2011, was classified as an EWE. The resulting flooding from excess rainfall was the worst the state has seen since 1927. Record flood levels were recorded in over half of the flow sites where previous "100-year flood" records were broken (NOAA, 2017; U.S. Department of the Interior: U.S. Geological Survey , 2014). TS Irene caused the most amount of statewide damage in Vermont's history (Vermont Public Radio , 2013). This research uses TS Irene in rural Vermont as an opportunity to investigate how a EWE affects short-term rural food security, and how social capital is used to strengthen rural U.S. resilience and enact food insecurity adaptation.

We focus on the three towns of - Pittsfield, Plymouth, and Rochester, VT (figure 2). Each town is distinct in that they do not operate under the same town governments– but all are located within the Connecticut River Drainage Basin and share similar location and floodplain (USDA NRCS, 2016). All three towns are considered rural within the range of key demographics: population size (range 546-1139), median income (range $48,750-$65,000), number of households (range 290-532), and percentage of household family units (range 58%-70%). As well, all three towns received FEMA public assistance funding (PAF) following TS Irene. Pittsfield received over $950 thousand,

Plymouth $1.4 million, and Rochester $2.7 million in PAF (Vermont Public Radio , 2013). All three PAF dollar amounts are considered commensurate relative to the town population, and these funds indicate that each community experienced devastating effects from TS Irene resulting in service loss and limited access to resources for a significant amount of time. In addition to a focus on these three towns, we also conducted interviews in Rutland, VT, as the larger supporting urban area for the three rural towns in the region of study. Two of the ten Rutland interviews had direct bearing on Plymouth, therefore some Rutland data are included as part of the Plymouth analysis.

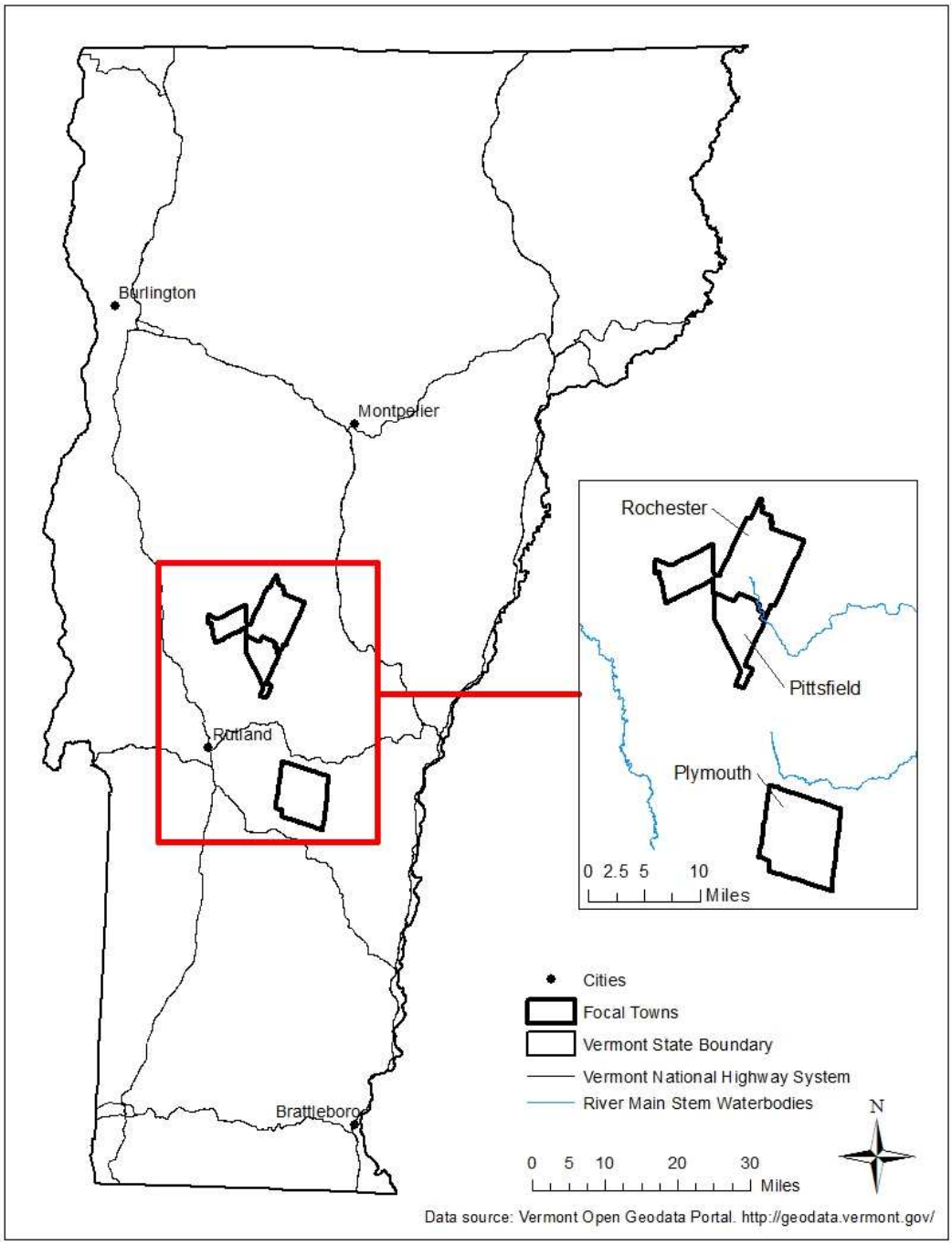

Figure 2. Study site town boundaries. Data source: Vermont Open Geodata Portal. http//geodata.vermont.gov/

Table 1. Key Stats for the three communities isolated by TS Irene

	Rochester	Pittsfield	Plymouth
Population*	1139	546	619
Family Households per capita*	.27	.28	.29
Vacant Housing Units per capita*[1]	.26	.35	.93
Schools and Libraries	2	1***	0
Non-Governmental Organizations**	14	6	5
Food Pantries	1	0	1
Grocery/Food Stores**	2	2	0
Restaurants/Inns**	9	4	0

*American Fact Finder (2010). Retrieved March 30, 2017

**Town Website and Google search. Retrieved March 30, 2017

***Library was opened two years after TS Irene

Methodological Approach

Prior to semi-structured interviews and participant observation, a bonding/bridging framework (figure 1), influenced by Putnam (2000) and Flora and Flora (2013), was created as a guide to gather perspectives and responses on community food insecurity related to climate shocks. The framework allowed interviews to maintain a community level response as opposed to collecting data on, for example, individual psychological experiences. The framework assisted in drafting cogent interview questions that helped subjects and interviewers focus on community perceptions. To capture the perspectives of multiple people impacted by, and involved in responses to the event, we interviewed farmers, town governments, food banks/pantries, local businesses, and

[1] U.S. Census definition of vacant housing unit: Vacant Housing Units. A housing unit is vacant if no one is living in it at the time of the interview, unless its occupants are only temporarily absent. In addition, a vacant unit may be one which is entirely occupied by persons who have a usual residence elsewhere. New units not yet occupied are classified as vacant housing units if construction has reached a point where all exterior windows and doors are installed and final usable floors are in place. Vacant units are excluded if they are exposed to the elements, that is, if the roof, walls, windows, or doors no longer protect the interior from the elements, or if there is positive evidence (such as a sign on the house or block) that the unit is to be demolished or is condemned. Also excluded are quarters being used entirely for nonresidential purposes, such as a store or an office, or quarters used for the storage of business supplies or inventory, machinery, or agricultural products. Vacant sleeping rooms in lodging houses, transient accommodations, barracks, and other quarters not 4 defined as housing units are not included in the statistics in this report. (See section on "Housing Unit."). Retrieved from https://www.census.gov/housing/hvs/definitions.pdf.

community organizers. Institutional Review Board (CHRBSS: 16-438) approval was granted prior to recruitment and interviews. Interview recruitment began in April of 2016 in collaboration with University of Vermont Cooperative Extension. We used purposeful sampling to find representativeness of the community setting before, during and after TS Irene, to capture heterogeneity between the selected communities (Maxwell, 2013, pp. 97-99). To participate, all interview subjects must have been present in central Vermont at the time TS Irene hit, and stayed in the community during the five years after the storm hit. We identified additional interview subjects through media reports covering TS Irene, publicly listed central Vermont food banks/pantries and town government officials. Snowball sampling (i.e. those we contacted and interviewed providing additional names of community members) was also used to contact additional interview subjects. In addition, researchers attended TS Irene five-year anniversary events; a town picnic (Pittsfield), TS Irene documentary screening (Plymouth), and public celebration (Rochester) to gain a better sense of the issue. Interviews were digitally recorded and lasted between 20 and 100 minutes. We interviewed a diverse range of community members in each area of study, and included two interviews from the Vermont Food Bank (table 2), until a saturation point was reached. All the recorded interviews were transcribed in Microsoft Word to enable analysis using N-Vivo 13.

Since collecting data on perceptions requires the research to be open and flexible (Maxwell, 2013), we used Strauss and Corbin's (1990) three stage grounded theory coding process. While the framework originally informed our development of questions, we utilized grounded theory to enable any themes to emerge from the data. Stage one, open coding, uses data to develop categories of information. After that, axial coding is

applied to find interconnected categories. Then, selective coding creates categories around the central phenomenon of food security and EWE, which elucidates the aspects of social capital in the context observed. Before data coding began, researchers double-coded a small sample (n=3) of interviews for calibration and consistency. Areas in which there was disagreement were discussed until consensus was reached on the emergent themes identified. We utilized a constant comparison method of data analysis. During data analysis, major emerging themes were placed within one or more of the sections outlined in figure 1. Themes that did not fit within the study focus were categorized, then analyzed for other emerging themes not anticipated in the social capital/food security framework.

Table 2: Interviews by category and location.

	Pittsfield (5*)	Plymouth (7)	Rochester (10)	Rutland (10*)	State (2)
Business owners (9)	1	2	4	1	
Farmers (9)		1	1	7	
Food Pantry/Food Bank (7)		1	2	1	2
Public officials / public school (5)	2	0	2	1	
Non-governmental leaders/general community member (6)	2	3	1	0	

*Two interviewees (one public official and one non-governmental leader) located in Rutland were included with analysis of the town of Pittsfield due to a direct bearing on Pittsfield's response to TS Irene. Table numbers reflect post-adjustment totals.

This study has a few limitations to the research design. First, the study is Vermont (VT) specific and can only speak about those who experienced TS Irene and food security issues in VT. The study can only peripherally indicate bridging social capital

outside of the town, and bonding social capital from one VT town to another. VT is not an island or geographically isolated, therefore neighboring states and other countries (i.e. Canada on the state's northern border) are likely to have contributed to the event and subsequent recovery. VT food insecurity ranks slightly below average among all fifty states making it neither the most food secure, nor the most food insecure place of study (USDA ERS, 2016). Though all interviews were confidential, some interviewees may have cast their town in a positive light, especially if they were a public official at the time. Furthermore, since many of the interviewees were prominent leaders within the community through business ownership, community work or government positions, it is possible that the perspectives captured here may be more representative of community leaders than community residents. However, many interviewees considered themselves a resident first, and their respective community role second. Lastly, the study used a small sample size (n=33) from four communities in the state. These limitations make generalization and inferences beyond the three VT communities this study focused on suggestive of future research but not conclusive in determining food security issues for the rural U.S.

Findings

Perceived Levels of Social Capital

Pittsfield

Prior to TS Irene, Pittsfield data indicates a high bonding/low bridging community existed. Pittsfield has opportunity to bridge with nearby ski-towns through jobs and small-businesses. However, because connections are primarily based on a

seasonal economy with high turn-over employment rates, varied seasonal conditions, and dependent on part-time residents, the continuity between Pittsfield and other towns is inconsistent. Though many Pittsfield residents had jobs and did shopping outside of town, the year-round residents gravitated toward staying close to their community as one business owner commented *"our community was the small town it was, and [my business] …had a solid local community clientele that we saw pretty regularly."* Pittsfield data indicated community bonding when a few years prior to TS Irene, a wealthy investor bought sizable portions of the town for business development. The community response was perceived to be a sharing of views opposing unsolicited ideas from an out-of-town investor, which solidified many resident's sense of place. The attitude formed galvanized residents to continue supporting local businesses, especially those in the food and service industry (grocery stores, restaurants, inns, and taverns), that shared town identity. These businesses are considered accessible to locals, unlike other towns in the region who mostly appeal to wealthier tourists. Community bonding also occurs during the long-running annual bazaar held every fall on the town green.

Plymouth

Plymouth data provide examples pointing to a low bonding/low bridging community prior to TS Irene. There are three key happenings prior to TS Irene that interviewees cited to support this; the closing of the only grocery store, the closing of the public school, and a divisive legal issue concerning recreational land-use.

The grocery store, owned by an out-of-state, non-resident, was closed years prior to TS Irene in hopes that upscale nearby ski resort development would open investment

opportunities. Closing the store meant the community no longer had *"opportunity for informal social cohesion"* because *"there's just no gathering place in town"*, noted one interviewee. One interviewee told of the community function the store had:

> "And just the daily interactions with a store – that's where I get my news in town. I find out what's going on. It's a chance to connect with people. That's how you build a community in those small connections."

When the town voted to close the public school for economic efficiency, many residents lost opportunity for interaction with other families. Directly tied to the school was an annual festival popular amongst locals. Today this event is held at a state park, but interviewees said the purpose has transformed to a general community event that now attracts more non-community members than Plymouth residents.

The third cited reason for low social capital is a legal battle over land access. This placed community members in three camps – those wanting more recreational land access, those supporting the land owner's ethos of conservation, and those who stayed out of the debate entirely. As one interviewee recalled of the battle, *"town relations were often strained"*, and communication was either contentious, or non-existent. When the town started interacting during recovery from TS Irene, one resident's perspective summed up the sentiments about town interactions: *"it shouldn't take a disaster to reach out to [your] neighbors"*.

Three lesser cited, but significant factors also indicated Plymouth had low bonding/low bridging prior to TS Irene. First, an annual hunting festival, no longer held, was a large, popular event that provided opportunity for interaction. Next, a local ski resort closed some years prior to TS Irene, and because it no longer operates, there is less

community interaction through employment and commerce. Finally, Plymouth has a high proportion of vacant housing units (Table 1). Some interviewees perceived these vacant homes, referred to as *"second home owners"*, as a hindrance to community involvement. One community member, who cited diminishing attendance to town hall meetings, gave a perspective on the effects of the series of changes in Plymouth:

> "If you have a really active, vibrant, healthy community, perhaps there's more socialization and more celebration…Plymouth used to have, for instance, an annual game dinner…it was a huge event – historical side – I know because we have pictures from these and so forth, and we don't do that anymore. They don't do that anymore. There's nothing in this town really that they do, other than the town meeting – there's nothing that they do annually that is for the town, that celebrates the town, that gets people out. There's no fair, there's no – it's just these little sporadic events here and there."

Rochester

The presence of high bonding/high bridging social capital prior to TS Irene was predominately found within Rochester. Prior to TS Irene, interactions and connecting with one another occurred on a regular basis, mostly through abundant public events and identity sharing. Bonding and bridging is created when community members gather multiple times a year at public events held at the town green, public library, and downtown church. Subjects illustrated these public events as means to social capital, which manifested during TS Irene. Many family descendants reside in Rochester, which maintain strong bonds lasting generations. Another form of social capital building is seen

with the numerous small, locally owned businesses that serve both the locals and tourists alike. The high bonding/high bridging social capital remained present during TS Irene, and has since transcended the EWE five years later. Themes of appreciation, confidence, and trust emerged in the interviews. One Rochester business owner described their sense of community then, and five years after TS Irene:

> "[Our community has] been made, I think, more powerful and impressive. I just love it even more. I mean, I really go to moments that we've been speaking about [TS Irene] …I've always really had that sense about this town, and [a strong community was] definitely pre-existing, but to see it blossom and fill out and serve such a fantastic need was really, really beautiful."

When asked about the positive bridging attitude perceived throughout the town, one interviewee said:

> "It's something I think is deep seeded in the community from the get-go…it's almost like something that was here [when I arrived]. Those of us, the newbies, it's really funny because you'll hear all these horrific terms [elsewhere], where people are called flatlanders and stuff, nobody ever throws that out there, it was not used here…but for those of us who have [recently moved] here, it's interesting since we find that almost the village finds us. So many people have moved here that are part of the community, and have so many very different and interesting stories as to why they ended up here, and [for us] it was not a choice [to become part of the community]."

Social Capital, Community Responses to Food Security, and Sense of Place

Pittsfield

The existing high bonding and low bridging social capital in Pittsfield was evident in the response to TS Irene from the community. The day after TS Irene hit, many community members arrived unannounced at the town hall, and expressed more concern about Pittsfield than they did their out-of-town jobs, or how other towns were fairing after the EWE. Because all access to other towns was closed indefinitely, a couple of wealthy out-of-towners booked helicopters to escape the village, but most Pittsfield community members participated in *"old fashioned"* means of communicating through message boards and word-of-mouth. One interviewees said: *"before the roads were open, we all felt very safe…when the roads opened up, it gave a very different feel because now there were outside people coming in."* This shared feeling motivated the town to set up a constable rotation to watch the *"outside people"*. Another interviewee said it was two weeks before the town felt normal with outsiders again.

The community member's quick response, fueled in part by strong bonding though a sense of place, had three impacts on food security during TS Irene. First, local food providers made food immediately available and accessible. A local food business freely shared all their food stock, and gathered a team of fellow workers to cook meals for residents to eat on the town green lasting two days. Another food provider accepted "I.O.U." notes on paper for residents who needed grocery supplies and were short on money and/or lost ability to cook (because of power and/or home loss). Second, food security support, driven in part by bonding social capital, is seen with the fact Pittsfield was the first town in Vermont to film, document and submit a written TS Irene FEMA

report so residents could accept federal funding supporting long-term livelihood (the video footage was later used to make a community documentary film). Finally, the rapid community action – residents who owned heavy machinery able to repair roads and bridges – made damaged roads passable faster than waiting for government road crews, allowing residents access to out-of-town stores, family, jobs, and resources, many of which resulted in stabilizing longer-term food security.

Despite having relatively low active bridging social capital prior to TS Irene, data suggests that immediately after TS Irene, kin from Pittsfield engaged in what lead to quick forming bridging social capital. This played a big part in mitigating food insecurity for a few weeks after TS Irene. Because some who grew up in Pittsfield lived in nearby towns unaffected by TS Irene, these individuals connected Pittsfield with community organizers in Rutland, and created what became known as the *"food train"*. This system used rugged mountain roads through National Forest to deliver 120 truckloads of food and supplies over 10 days following TS Irene. Pittsfield served as the hub for *"food train"* deliveries, and the trust perceived through a shared sense of identity made possible the distribution of excess supplies to five other towns in the area. By the time the National Guard arrived with meals-ready-to-eat (MRE), the town's people did not need these supplies, as evident with over 15 cases still untouched when this research was conducted five years after TS Irene. One interviewee reflected on the trust and resilience of the community:

> "I think it was a good, strong little community before Irene. I think the community has a better sense of community since then. A lot of people looked out for other people [in the community] during that period…all worked together to get those

roads cleared off and ready for being – getting back into town…the National Guard came through and got up and helped out…there were some community members that never felt that we would get to that point [of needing the help of the National Guard], and may have felt that we didn't need them [at all]."

Sense of Place

In Pittsfield, considered a high bonding/low bridging community, a sense of place comes from the location of the community, as one subject described it; *"I really feel like this place is special and the people come here because of that"*. The idea that the people make their community a special place was expressed in relation to the town size. The Pittsfield interviews elude to the idea that if Pittsfield remains small (in population), it will retain the feeling of accessible community bonding. When considering the future of Pittsfield's ability to bond, one interviewee said:

"I would like to hope that [Pittsfield is] still small enough and still – I mean because there's checks on neighbors, all that sort of thing – I hope that we're still small enough that we can be that [dependent upon one another]."

Plymouth

While bridging and bonding social capital was low prior to TS Irene, key community members had an underlying desire to create better connections. One interviewee, who held a deep desire to mend strained town-organization relations, viewed the disaster as a chance to make *"a generational shift in attitudes in the town."* The day after TS Irene, a local organization, which operates partially as a farm, used bridging social capital to provide their abundant food stock, and cooked meals at the town hall for

anyone who needed/wanted food. For 12 consecutive days, 14 hours a day, they made multiple meals a day, each feeding between 10-12 residents. One organization member recalls their group reaching out to the town:

> "We started checking in [on the community], and said 'hey, why don't you come to dinner, we'll be cooking 3 meals a day, stop in', and word gradually spread around the [town]. So, we had people showing up for meals…we went down to the [town hall] to see what was going on, how we could help, and just put word out there that 'hey, we're cooking 3 meals a day; please feel free to stop by'."

The organization further used their intra-bonding social capital to campaign and bridge their member affiliates near and far. The result amassed a volunteer corps that labored doing recovery work in the town for 6-8 weeks after TS Irene.

Another emergence of Pittsfield bridging social capital occurred at the opposite end of town. A business owner reached out to other businesses and the town's only food pantry to orchestrate a centralized kitchen preparing meals for residents working long days repairing roads and homes, and delivering food to known vulnerable residents who lived in remote, hard to access areas, or whose homes and/or means of preparing food were destroyed. The same food orchestrators traded extra government food supplies with a nearby town for clothes, hygiene and cleaning supplies. By the time the National Guard (NG) dropped off MRE's a couple days after TS Irene, the town had mitigated known food insecurity, and thus attempted to *"wave off"* the helicopter during the NG's final MRE drop.

Sense of Place

In Plymouth, considered a low bonding/low bridging community, interviewees attributed their sense of place to the community interaction (or lack thereof) within their community. With the closing of key institutions and businesses in the years prior to TS Irene, those who felt Plymouth's community members make the place special also recognized that the lack of community involvement in recent years had lowered their special feeling and weakened their sense of place. One Plymouth community member summarized the transformation of turning into a *"typical American community"*. This indicated in years prior to TS Irene they perceived their community was once unique, but is now a town devoid of notable community like the rest of the U.S. This feeling was complimented with multiple Plymouth subjects mentioning the area's second home owners, and how those who did not reside in Plymouth were absent during the recovery period after TS Irene. Three interviewees cited how a few second home owners, who were in their Plymouth homes at the time of TS Irene, hired private helicopters to evacuate the area a day or two after the storm.

Rochester

Because of a perceived high bonding/high bridging social capital, residents of Rochester felt they had an effective response and strong support for each other prior, during, and after TS Irene. One interviewee described how the community members responded during TS Irene:

> "Everybody fed everybody…the [local farms and businesses] took turns putting on meals…it was unreal, it was absolutely phenomenal. It was the most incredible humbling experience. I cannot begin to tell you how humbling it was… [volunteers

who will] cook for everybody…they set up the food system for everybody in the village."

Rochester interviews depict a community mitigating food insecurity during TS Irene through a strong community approach, though multiple instances. First, every interviewee (n= 10) cited the public school as central to the community resilience. During the two-weeks post-storm, the school served as the central shelter, mess hall, and food hub for the entire town. Without hesitation, businesses and community members freely brought food to the school kitchen, where a gas powered refrigerated trailer was on loan from the local National Forest Service station. For 10 days, meals were prepared and served from this community-pooled food stock. Subjects viewed the presence of a school in town as a place for families to interact with other community members, including those with and without children, and could become aware of each other's food security needs (e.g. no ability to prepare food, flood destroyed food stock). In addition to the school meals, many local businesses prepared free meals, and delivered food to all those repairing roads and homes, including crews arriving from out of state (a display of high bridging).

The local food pantry also played a part in augmenting food security by extending open hours for several days after TS Irene. Volunteers at the food pantry personally knew of families in the area that were food insecure, and helped meet their food needs through extended food pantry services. Other food resources were saved for known large households (by way of family and/or guests) who could not access food resourced due to road damages. These families were ensured that food supplies could reach them through a network of shared information.

The day after the storm, community members gathered food from their homes on the town green, and local businesses cooked meals for anyone who showed up. When asked about who attended the free public meals, which lasted for three days, one interviewee replied: *"It was everybody. They just came down and had a party."* No perceived food insecurity was caused or worsened by TS Irene, and subjects attribute much of this to an ambiguous *"special"* community feeling. For example, though the town had no emergency plan, by the time the National Guard dropped off pallets of MRE's, the town social capital, shared food resources, and accessible meals, already supported community food security. When some veteran members of state emergency relief crews arrived a few days after TS Irene, they shared the perspective that in no other incidence had they seen such a resilient, supportive response to a town emergency as witnessed in Rochester. One interviewee shared this outside perspective:

> "I would give [a community volunteer] a tray of [food] and say, 'go feed somebody'…we were taking care of the [emergency crews from outside of Rochester]. We had one [crew member] who said, 'ma'am, can I take your picture?' And [they] said, 'what!?'. And he said, 'you don't understand, when we go to other places, this doesn't happen. We don't get taken care of like this. I mean, you're walking across this little [thrown together] footbridge…to hand me a cheeseburger…we're kind of amazed about that'. That's one of the things I remember, is that the medical people and the emergency workers that came in, they could not believe how [well] we were taking care of ourselves."

Sense of Place

In Rochester, considered a high bonding/high bridging community, subjects reported the most salient sense of place. All ten interviewees felt their community was special. The source of this special feeling, their "sense of place", was perceived to come from a mixture of community members and the physical location. One long-time community member went as far as to say they lived in the *"greatest place on Earth"*. Of the ten Rochester interviewees, eight stated both people and location (physical and natural capitals, combined with human and social capitals) are what make a place special. Of the other two interviews, one stated the location is what creates a sense of community, and the other said it was the people, not location, that gives their community a special feeling, a sense of place.

Discussion

Our results suggest a strong relationship between existing community social capital and community responses to EWE as it relates to mitigating acute community food insecurities during short-term recovery processes. We find evidence that in communities with prior low bonding and low bridging social capital (Plymouth), their response to TS Irene was not a community collective action; rather, it was coordinated by one strong central actor whose leaders had a desire to strengthen community ties. Conversely, we find in Pittsfield, where high bonding social capital existed, the response was intra-community oriented as food resources were immediately provided to community members. Though Pittsfield did not have strong, active bridging social capital

prior to TS Irene, ties through kin and economy with nearby communities (as drivers for bonding social capital) made bridging social capital easy to arise in the days after TS Irene, resulting in the town's ability to uphold food security until access to other resources were available. Further, in Rochester, where both high bridging and high bonding social capital existed prior to TS Irene, a community oriented response to TS Irene involved many people, and a diversity of events and strategies. Rochester quickly pooled food resources to successfully mitigate food insecurity for community members, non-community members (outsiders), and state emergency relief crews alike. As such, in the three communities, we find evidence that the social capital existing prior to an EWE was significantly perceived by the people living to influence the short-term response of the community to TS Irene. Below we discuss these results in the context of the academic literature as well as the empirical implications for climate adaptation to EWE.

These findings support the concept that social capital is critical for resilience, adaptation, and recovery efforts after a disaster (Weil, Lee, & Shihadeh, 2012; Aldrich & Meyer, 2015; Aldrich, 2017; Clay, Colburn, & Seara, 2016; Morton & Lurie, 2013). Collective resolution was observed in in the high bonding and/or high bridging communities where multiple actors sought to quickly find solutions to community food insecurity by combining private organizations and public infrastructure. As seen within fishing communities recovering after Hurricane Sandy (Clay, Colburn, & Seara, 2016) and in other work on recovery groups after TS Irene (Consoer & Milman, 2016), our study lends supports to the idea that community social capital allows people to utilize mechanisms for collective resolution to more easily solve problems (Putnam, 2000, pp. 288-290; Woolcock & Narayan, 2000). Mutual trust, collective identity, and working

together toward a shared future (Flora & Flora, 2013, p. 11) was observed in the two high social capital communities, each displaying intra-community trust to adapt to the aftermath of the storm by sharing resources to equally feed everyone, and quickly accessing hard to reach residents through patchwork road access and door-to-door neighbor checking. This is consistent with research focused on Hurricane Katrina, where those with more social capital help those in need the most (Weil, Lee, & Shihadeh, 2012). These same communities displayed resilience by not requiring outside resources to reach community stability, which is consistent with recovery efforts after Hurricane Sandy (Cagney, Sterrett, Benz, & Tompson, 2016), and with regards to local governments after Hurricane Katrina (Weil, Lee, & Shihadeh, 2012).

In the low bonding/low bridging community of Plymouth, a lead organization was necessary to bridge the community together to set the norms, understandings, and expectations about the interactions of groups (Ostrom E. , 2000) after TS Irene. Though low bonding/low bridging communities tend to be highly independent (e.g. families look out for their own needs and do not consider the community), this is consistent with findings after Hurricane Sandy observing independent communities using social bonds at the neighborhood level as resilience to an EWE (Clay, Colburn, & Seara, 2016). These results suggest that prior intra-community independence (low bonding/low bridging) does not always inhibit cooperation, and informal social cohesion is capable of sufficient community resilience (Cagney, Sterrett, Benz, & Tompson, 2016).The subjects' perception of social capital was not strictly assessed from the reported actions and perceptions of community responses to TS Irene. Underlying most subject's positive perception of social capital is the notion of their community being "special". This idea

surfaced in nearly all the interviews of each of the three communities – Pittsfield, Plymouth, and Rochester – with differences between interviewees feeling of a "sense of place". These differences appear to depend on which community their perceptions were part of. The high social capital communities attributed their feelings about the specialness of their community to the town location, size (low population), and/or the public and private infrastructure (businesses, town centers, schools, etc.). The low social capital community felt "people" make a place special. This is interesting considering the low social capital community also had a lack of infrastructure, the size of the town relative to the vacant housing (table 2), and the reported decreased community involvement in years prior to TS Irene. In the absence of community social capital, some form of networking needs to occur to fully address acute food security issues after an EWE.

Drawing upon social network theory (Provan & Kenis, 2007), these results suggest that different community structures, and resulting levels of community social capital, may have strongly affected the post EWE responses. In the low bonding/low bridging community of Plymouth, where a strong central actor played a critical role in coordinating relief efforts, this suggests a brokered network structure where the organization used their intra-bonding social capital to activate bridging social capital, which helped forge a shared sense of place – the idea of the organization and community members as neighbors and should take care of one another – immediately after TS Irene. This was seen with organization's free distributed meals at town hall, and the amassed volunteer force helping recovery efforts in the weeks after TS Irene. The sudden bridging social capital fostered enough of a bond between community members who previously had weak or strained ties that immediate food security needs were addressed. Conversely,

more shared networks of governance are demonstrated in Pittsfield and Rochester where multiple actors and types seemed to come together, albeit with different levels of inward or outward facing capital. In Pittsfield, existing bonding social capital was more responsive to immediate needs and short-term recovery due to already established intra-community trust. A core group of people comprised of town officials, business owners, and community leaders acted as the central actor to mitigate acute food insecurity issues. Because trust and reciprocity was established prior to TS Irene, bridging social capital stemming for a lead organization (as observed in Plymouth) was not necessary - that role in Pittsfield was informally filled with community members taking care of each other. In Rochester, both bonding and bridging social capital allowed trust and information to spread quickly and effectively to intra and extra community groups as their immediate post-TS Irene food security needs were abundantly met. This is because the town government, acting as a central actor, worked in tandem with other intra and extra community groups resulting in everyone within the Rochester network to fully address acute community food insecurity. Within both Pittsfield and Rochester was accessible infrastructure such as an active school, local businesses, and centralized public space (town centers, town greens). Using social network analysis in combination with the type of social capital (bonding and bridging), and the elements supporting the creation of social capital, can provide a step toward untangling the complexity of social networks and social capital at the community level (Mandarano, 2009)

Our results suggest that bonding *and* bridging social capital played separate roles in assisting short-term relief efforts and food security following an EWE. This finding differs slightly from a study showing that after flooding in Illinois, bonding social capital

was more important for immediate recovery needs, while bridging social capital was more important for long-term needs after an EWE (Casagrande, McIlvaine-Newsad, & Jones, 2015). In our study, bridging social capital became important in meeting acute food security needs when the levels of both bonding and bridging social capital was low prior to an EWE. In this context, with a community with perceived low bonding/low bridging, bridging social capital becomes more important than bonding social capital so a central actor can assist with acute food insecurity issues during and immediately after an EWE. What was discovered in Plymouth was a need for the community to share a sense of place to make social capital effective in the absence of bonding social capital, and this shared sense of place was (re)realized immediately after TS Irene due to the motives of a key organization bridging the community together and raising both bonding and bridging social capital to a community level.

The theory emerging from this study concerns the level of social capital and community members' sense of place in relation to community adaptation and resilience after an EWE. It has been shown that individual social connectedness and sense of place are positively linked to individual resilience in rural areas (Boon, 2014). The stronger a sense of place is felt by individuals within a community, and the more social capital a community is perceived to have, the more likely that community will remain stable in population and socio-economic indicators. While our study generally agrees with this idea, what remains to be understood is if a community's sense of place increases social capital, or does social capital heighten a sense of place? To put this in terms used for the research subjects, it is the place or the people that make a place "special"? Diving into the theories on this topic is beyond the scope of this study. However, we ask the following

questions for future research to investigate; is a sense of place stronger with bonding, bridging, or a combination of social capital types after an EWE? How does a sense of place factor into the affects social capital has on community resilience and adaptation to EWE in the rural U.S.? Based on our findings, we theorize that a sense of place has a strong effect on the degree and type of social capital, and the higher the degree of social capital within a community, the more resilient and adaptive a community is to acute needs, such as food security vulnerabilities and food insecurity caused or worsened by an EWE.

Our work further contributes to the call for greater social science research to facilitate resilience in disaster recovery (Aldrich & Meyer, 2015; Aldrich, 2017; Weil, Lee, & Shihadeh, 2012). This study shows that the perceptions of disaster victims influence community recovery processes, and the more social capital stock a community contains, the more adaptation stems from informal community based organizations; the less social capital stock a community contains, the more likely a central agency (or organization) is supplying adaptation strategies on behalf of the community (Consoer & Milman, 2016).

Further research beyond a focus on disaster recovery, EWE and the role of social capital should focus on the relationship of social capital to food security independently. Our findings support studies showing food security positively associated with perceived levels of social capital with groups informally sharing information about food resources, and those that have trust and reciprocity within their community (Walker, Holben, Kropf, Holcomb, & Anderson, 2007; Dean & Sharkey, 2011). Our findings differ from other studies in that the community reporting perceived low levels of social capital prior to TS

Irene was still able to be food secure with the quick creation of bridging social capital, thus supporting the idea of social capital as a beneficial public good (Coleman J. S., 1990).

Our results suggest that building community social capital in rural areas could be critical for future climate change adaptation and resilience in the context of food security, yet levels of social capital can be low in rural communities (Hofferth & Iceland, 2011). Networking organizations and community leaders connecting with community actors and stakeholders is well-established as critical for successful community development (Perkins & Court, 2005) and disaster resilience (Jung & Song, 2015). By analyzing community social capital through the perceptions of community members and discovering that both high levels of bonding and bridging social capital can mitigate acute food security needs after an EWE, we provide context to the idea that some community members are more likely to rely on community development for future disaster preparedness. Community development can promote a positive sense of place through public institutions, local government involvement, locally owned and operated economies, and open public events focused on the community. Since 2007, U.S. rural communities have experienced population loss, increased poverty rates, and lover employment growth rates than non-rural U.S. communities (USDA ERS, 2016). Rural communities and small towns often do not have the necessary capital investments to build large-scale food security infrastructure, fund public schools, attract local business investments, and hold community focused public events. By neglecting community development as a social capital building mechanisms, it can render existing low social capital communities more vulnerable to future climate impacts and EWE. Our study

suggests that fostering the development of social capital, both bridging and bonding, is critical to assist rural communities in building resilience and adaptation for effective community responses to EWE and climate impacts.

While we provide empirical evidence from three communities in Vermont about the relationship of community social capital and EWE and its implications for community food security, we acknowledge the limitations of our study. As such, we suggest that additional research in rural regions across the U.S. should be conducted to see if variations in culture, demographics, landscape, resources, and regional history affect social capital's response to extreme events that disrupt local food systems. Expansion of our research would include correlating the above variations of social capital before and after EWE with a sense of place, a concept needing further attention in empowering rural development (Bell, Lloyd, & Vatovec, 2014) and expanding rural social sciences (Bell M. M., 1997). Future studies can be conducted within urban areas to see if social cohesion within city neighborhoods and/or districts can benefit from social capital as means to adaptation and resilience in the face of climate change induced EWE. Future research could also integrate more quantitative data by measuring observed social capital, and correlating this to variations listed above, after EWE in different regions, both domestically, and abroad. We also suggest that beyond the limitations of our study, our work elicits several potential future studies. Future research should further explore relationships between perceived social capital and rural development and infrastructure investments by bringing in quantitative data on income, employment, time between EWE, and the level of damage/loss from EWE in rural communities, and qualitative data on social capital and a sense of place. Possible areas to investigate are economic

development, and how the closure of businesses, the type of ownership (locally owned vs. corporate owned), and the type of new business development (tourism, resource extraction, manufacturing) influence social capital. These potential studies can investigate the closures of public schools, and to what extent small rural public schools support rural adaptation and resiliency in different social capital context, and does the closure of rural public institutions affect the community's sense of place? Here we've provided some potential indicators to explore these factors in greater context and additional regions in future research.

CHAPTER 6: CONCLUSION

After TS Irene, both bonding and bridging social capital influenced rural community responses to an EWE, which led to effective action improving and stabilizing community food security. Our results indicate that rural communities with high levels of bonding and bridging social capital facilitates a collective community response to ensuring short-term community food security during and after an EWE. These communities were effective at quickly implementing strategies to provide food and services to those both within and outside the community. Conversely, low levels of bonding and bridging social capital resulted in more individualized approaches, or in the case of this study, a single organization emerged as the community disaster responder rather than fluid collective action. Without a central actor to instigate bridging social capital, the community's ability to mitigate acute food security issues during and after an

EWE is left in question. Both social capital and network theory suggest that absent such a central organization to create community resiliency and adaptation by way of bridging social capital, the community response to an EWE would have been less effective at mitigating acute food security issues. Rural communities without high bonding and/or bridging social capital will have less community resilience and adaptation, and will be less likely to successfully mitigate acute food insecurity during future EWE.

Through grounded theory analysis, we discovered that the community response to an EWE is more than resiliency and adaptation supported by degrees of community social capital. The perceptions of community social capital appear different in relation to their sense of place. Communities with high levels of social capital prior to TS Irene were far more likely to see their community as "special" because of the physical location the town resides in, as well as the people of their community. Communities with low social capital were more likely to mainly view people, and not the location, as to what makes a place "special". In our study, the community with perceived low social capital prior to TS Irene in which reported that the people, not the place is what create "specialness", or a sense of place, in their community, lacked public infrastructure (i.e. open public school), a vibrant local economy (empty commercial buildings), community focused local events, and had higher percentage of vacant homes (referred to as "second home owners") compared to the communities with high community social capital prior to TS Irene. Emerging from our study is the theory that the level of social capital and community members' sense of place prior to an EWE affects the community in relation to community adaptation and resilience during an EWE to deal with acute issues, such as food security. As such, we suggest that promoting the development of social capital

within rural communities through community development - creation of public events, investment in public infrastructure and schools, and the promotion of locally owned and operated businesses - can build resiliency and adaptation to future EWE by promoting the growth of community social capital, both bonding and bridging, within rural communities. Rural development could place more focus on facilitating social capital, and how the level and type of social capital can benefit community food security in the face of climate change induced EWE.

To our knowledge, no research has looked at the influence of social capital on a U.S. rural community response to an EWE, and its impact on community food security. In our attempts to fill the gap in social capital research and climate change resiliency and adaptation to EWE, we recognize the need for more research build off our study. We recommend future research investigating how a sense of place is felt by individuals within a community, and if the more social capital a rural community is perceived to have, the more likely that community will remain stable in population and socio-economic indicators. It is still not well understood if a community's sense of place increases social capital, or does social capital heighten a sense of place? Is the place or the people that make a place "special"? Based on our findings, we theorize that a sense of place has a strong effect on the degree and type of social capital, and the higher the degree of social capital within a community, the more resilient and adaptive a community is to acute needs, such as food security vulnerabilities and food insecurity caused or worsened by an EWE. Future research should further explore relationships between perceived social capital and rural development and infrastructure investments by bringing in quantitative data on income, employment, time between EWE, and the level of

damage/loss from EWE in rural communities, and qualitative data on social capital and a sense of place. Possible areas to investigate are economic development, and how the closure of businesses, the type of ownership (locally owned vs. corporate owned), and the type of new business development (tourism, resource extraction, manufacturing) influence social capital. Here we have provided some potential indicators to explore these factors in greater context and additional regions in future research social capital, climate change, and rural development research.

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APPENDIX

Semi-structured interview guide

A. General Research Questions for All Subjects

- Where were you when Tropical Storm Irene struck Vermont on August 28th, 2011? *Note*: this question will be asked prior to interviewing (over the phone, email) to help determine if the subject is a qualified candidate for this study.
- Tell me about your experience. How did you prepare, if you did, for the event? What happened during the storm and immediately after?
- (briefly) Did you experience any adverse impacts like losing power, phone service, or transportation? *Farmers, business owners, food pantry locations*: property damage, or business damage?
- Did you experience any shortage in food or water? If so, how did you handle this shortage?
- Did you utilize any emergency services from the Red Cross, or a food pantry, or the local or state government to obtain food or water during TS Irene? Afterward? For how long were you using these services?
- Did others in your community assist you at all during or shortly after the event?
- Do you feel the organization you used was best prepared to serve this community? How do you think they serve the community now?
- Did you receive any assistance from someone *you know* such as family, friends, neighbors, and/or community members?
- Have you during or after TS Irene given any assistance to others within the community?
- Were you aware of any town or state emergency plans to follow? If so, how did you learn about this? Did you know of a town or state emergency management plan to follow? Do you feel as though local governments and organizations are accessible?

- Did you receive assistance from any community or business members you were not well acquainted with prior to the event? Did you provide assistance to any community or business members?
- How did you know about these services? How did you contact them?
- Did your [business, family, farm, town, church, etc..] have an emergency management plan prior to TS Irene? Have you made any changes to an existing disaster management plan, or added a disaster management plan since TS Irene? Do the plans account for short-term action, long-term recovery, or both?
- Do you consider food needs in your emergency management plan? If you do not have a plan, how would you address any food shortages caused by future weather events like TS Irene?
- How do you think the recovery process has developed in the last five years? Is there more work to be done? Do you believe food security has been sufficiently addressed in emergency management planning since TS Irene?
- Other than having adequate access to food and the means to buy it, what other important factors have you considered to deal with an extreme event since TS Irene?

B. Additional Questions for Farms/Farmers, Local Businesses

- Did your farm or business provide any food contributions to the community following TS Irene? Did your farm or business specifically help other farms or business for storm mitigation and/or recovery? How about any collaboration with another farm or business for post storm recovery? Do you still have these connections?
- What did TS Irene do in terms of food production for the community you serve?
- Did you receive funds from any federal agency such as FEMA? Did you receive funds or other type of assistance from a state or community recovery project committee? Did you receive funds from any other sources of disaster relief? If so, what were the funds for? How were they used?

- Has your farm/business undergone any changes since TS Irene to mitigate the effects of future extreme weather events on food production? Does your farm/business promote volunteering and community engagement for its employees? How do you stay connected to those in your community, and with whom do you connect with?
- Do you feel that your farm could withstand another event like TS Irene in the next five years? Longer? Shorter? How are things different from before the store with emergency food resources?
- Do you believe your farm will be affected by future climate change events? How about food production in the [community, town, food, farming region]?

C. Questions for Policymakers, Government Workers, Agency Staff, or Non-Governmental Organization Members.

- What type of emergency management plans were in place in (town/state) prior to TS Irene? Do you believe this plan was effective during TS Irene? After? Today?
- Was food security a part of the emergency management plan prior to TS Irene? If not is it now? If so, has it changed? Please explain.
- What were the impacts of TS Irene on the food security of the community? How did this storm impact food security for households? Farmers? Businesses?
- How did your office/organization assist community members' food insecurity before TS Irene? During? After? What services did [agency] provide to those in need? What community, and who within that community did you serve? How did people know about these services?
- Do you believe the [agents] response to food insecurities during TS Irene was effective? How could it have worked better?
- Do you believe how well everyone knows each other [a tight knit community/social capital/the social fabric plays a role in providing food security? What about belonging to a local organization or club? Please explain.

- Have there been any changes to dealing with food insecurity during a crisis response since TS Irene? If so, have any of these changes included how to better network and disseminate information?
- If another extreme weather event like TS Irene were to strike in the near future, do you believe more, less, or the same people will be food insecure during and after the event?
- If so, do any of these areas of improvement address food security needs?

D. Additional Questions for Consideration

- Did your ability to connect with others have a role in addressing food security during TS Irene? Do you trust the community to help you in times of need?
- How did you view others in the community before TS Irene? Did people trust one another during and after TS Irene? ~~Was~~ What does that trust look like today?
- Do you live in a food secure community?
- In what ways, does knowing one another contribute to food security before TS Irene. Did TS Irene bring people together that were not previously known to each other? Are these bonds still felt today?

E. Question to ask each interview subject before concluding session

- Do you know of anyone who we may want to talk to, and who would be willing to speak with us about TS Irene?

Coding Table

Table 3. Identified themes during coding from interviews (n=33); stage 1 & 2

Stage 1 – Open Coding			Stage 2 – Axial Coding		
Topic	Sources	References	Case	Sources	References
Agencies	16	47	Definition of community	29	45
Barriers	21	56	FEMA, Red Cross, other Federal and State Responses	16	33
Businesses	27	97	Food Security: Access - Good Standing	28	77
Events/Anniversaries	14	28	Food Security: Access – Not Enough	25	51
Climate Change/Extreme Weather Events	11	27	Food Security: Availability – Good Standing	30	97
Communication	26	85	Food Security: Availability – Not Enough	18	27
Economy	15	43	Food Security: Stability – Good Standing	21	37
Farms	16	79	Food Security: Stability – Not Enough	26	74
Federal/State Support	20	76	Food Security: Utilization – Good Standing	26	65
Food Bank	15	67	Food Security: Utilization – Not Enough	19	40
Community Health/Medical	11	19	Food Security: Before TS Irene	8	14
History of Community	9	17	Food Security: As Safety Net	14	32
Housing	5	12	Preparedness for Future Responses to EWE	31	74

Infrastructure	22	54	Government Support – Too Much	15	21
Local Responses to TS Irene	29	127	Local Communications	21	48
Media	15	45	Refugees	5	9
Meals-Ready-To-Eat	15	26	Resiliency	18	40
Non-Governmental Organizations	23	69	Social Capital: Agencies, Governments, and Non-Governmental Organizations	22	58
Community Perceptions Changes	33	184	Social Capital: Bonding – General	16	29
Food Security Pillar: Access	30	168	Social Capital: Bonding – Pittsfield	4	41
Food Security Pillar: Availability	32	170	Social Capital: Bonding – Plymouth	7	64
Food Security Pillar: Stability	31	147	Social Capital: Bonding – Rochester	10	95
Food Security Pillar: Utilization	29	119	Social Capital: Bonding – Rutland	7	54
Disaster Preparedness: Before TS Irene	29	92	Social Capital: Bridging – General	13	25
Disaster Preparedness: Future Events	30	83	Social Capital: Bridging – General	13	25
Community Resilience	28	105	Social Capital: Bridging – Pittsfield	7	32
Social Capital: Bonding	31	265	Social Capital: Bridging – Plymouth	7	60
Social Capital: Bridging	33	332	Social Capital: Bridging – Rochester	12	79

Social Capital: Community	33	270	Social Capital: Bridging – Rutland	8	62
Social Capital: General	3	3	Social Capital: Farmers	13	92
Social Capital: Networks	21	71	Social Capital: Food Bank / Food Pantries	6	25
Public Schools	20	41	Sense of Place	21	28
Sense of Place	28	54			
Comparing Community "Then" to "Now"	20	49			
Water (not food)	12	25			

Below is a table representing the third stage of coding. The table is far from comprehensive. Selective coding is the culmination of notes, memos, and interpretations after multiple analysis and reviews of data. The "definition of community" column is a summary of the interviewee response using specific wording from the transcripts. The "type of social capital" column indicates the leading modes of social capital the matching datum indicated after analysis.

Coding Stage Three – Selective

Table 4: Definition of interviewees community (n=33), and type of social capital selected from interview

Interview Number	Definition of Community	Type of Social Capital
#1	Those within a given infrastructure and government	LBD, LBR, HBR
#2	Rochester, Liberty Hill	HBD, HBR
#3	Agency clients	LBD, LBR
#4	Chittenden, Rutland County, Pittsfield, Milton, family	HBD, HBR
#5	--	HBR
#6	farms, those with whom business is conducted	HBR
#7	Warren, Waterbury, south-central Vermont, defined by regional and geographical boundaries, the valley (which they live in), the state (of Vermont), the country (U.S.), sense of place	HBD, HBR
#8	Rochester	HBD, HBR
#9	unsure, people are people everywhere, that is community	LBD, LBR
#10	Rutland area, including outlying towns, generational	HBD, HBR
#11	Dartmouth, Hanover, Woodstock, Middlebury, Burlington, the well-being of where they live, the environment	HBR
#12	20-mile radius, Shewsbury, Windsor County, Rutland to Ludlow, farmers' market, farm to community members	HBD, HBR
#13	Vermont, New England, Feeding America	HBD, HBR, LBR
#14	Vermont, sense of place, generational	HBD, HBR, LBR
#15	Organization a part of, New England, U.S.	HBR, LBD, LBR
#16	Church, library, those at public events, Liberty Hill, public school, school game attendees, government board members	HBD, HBR
#17	Pittsfield, Stockbridge, Killington	HBD
#18	The environment, neighbors, friends, family, seniors of Rutland	HBD, HBR, LBR

#19	Church, local youth camp, beekeeping group, farmers' market vendors and customers, Vermont Youth Conservation Corps, Wallingford	HBD, HBR
#20	--	LBD, LBR, HBR
#21	Plymouth and surrounding area, Dartmouth, Hitchcock, Ludlow, Proctorville, Redding	LBR, HBD
#22	those who get things done within the community	LBD, LBR, HBD
#23	--	LBR
#24	50-mile radius	HBD, HBR
#25	20-mile radius, Rochester, Killington,	HBD, HBR, LBR
#26	volunteer fire department, local club group, local businesses, church, public school	LBD, HBR
#27	Rochester	HBD, HBR
#28	Benson, customers in 3 or 4 counties	LBD, LBR
#29	20-30 people who get things done in the community, Bridgewater, local non-governmental organizations, church leaders	LBD, LBR, HBR
#31	local business owners, church, neighbors, sense of place	HBD
#32	Killington, Pittsfield, business customers	LBR, HBD
#33	salt of the earth people, business owners	LBD, LBR, HBR

Note: HBD (high-bonding), HBR (high-bridging), LBD (low-bonding), LBR (low-bridging). (--) Did not provide a definition of community.