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Does tourism matter in measuring community resilience?

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ABSTRACT

As damage from natural hazards is increasing, quantifying community resilience is a top priority in enhancing communities' ability to prepare for and recover from disasters. This study examines the significance of tourism in measuring community resilience by proposing a tourism community resilience measurement model. To identify key tourism industries that significantly improve community resilience, this study also explores the spatially heterogeneous associations between the validated community resilience metric and tourism industry specialization across 67 counties in Florida. The results indicate that the tourism dimension is important in measuring community resilience and that specific tourism sectors, including amusements and spectator sports, are positively associated with community resilience. These findings can help community policymakers develop localized resilience enhancement strategies by considering tourism.

Introduction

Communities worldwide face increasing risks from multiple natural hazards (Opdyke et al., 2017). As such disasters tragically affect the sustainability of communities, including their socioeconomic and environmental functions, researchers and policymakers have tried to enhance communities' ability to quickly overcome disasters (Norris et al., 2008). Within a socioecological system, the capability of a community to prepare for, respond to, and recover from disasters while mitigating future impacts is called community resilience to disasters ("community resilience") (Cutter et al., 2014; Lam et al., 2015). The concept of community resilience not only reflects a recovery step after disasters but also includes a series of processes before, during, and after disasters, leading to sustainable community development (Lam et al., 2016). To effectively manage community resilience and to precisely gauge the success of disaster risk reduction, quantifying community resilience has been recognized as a top priority for policymakers and researchers (Cutter & Derakhshan, 2020; Lam et al., 2016).

There have been steady developments in studies measuring community resilience, especially those studies that have predominantly been conducted in the fields of environmental science and geography (Cai et al., 2018). Researchers have focused on developing measurement frameworks (Lam et al., 2015) and community composite indicators (Cutter et al., 2010; Powell et al., 2018) to accurately measure community resilience. Prior studies have also examined the key determinants that significantly affect community resilience, such as residents' risk perceptions (Powell et al., 2018) and social learning (McEwen et al., 2017).

Despite these efforts, community resilience measurement studies have faced two main issues: (a) a lack of measurement models that consider the tourism dimension and (b) validation. First, to date, little attention has been given to the role of tourism

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in measuring community resilience and the relevant impact of tourism industries on community resilience. Tourism is highly associated with socioecological elements, which significantly affect the degree of resilience (Ruiz-Ballesteros, 2011). Tsai et al. (2016) showed that tourism can enhance community resilience by building the capacity of communities to undertake an adaptive response to natural hazards. Recent studies have also proven that tourism demand is positively related to community resilience as demand leads to economic growth, which is one of the main factors in building community resilience (Mazzola et al., 2019; Romão, 2020). Although prior studies have shown that tourism is positively related to community resilience, tourism has barely been considered a key measurement factor, and there has also been a lack of research on what types of tourism industries are significantly related to community resilience.

Second, prior studies have struggled to empirically validate the resilience indices that have been derived (Cutter & Derakhshan, 2020). The validation of community resilience metrics is an important stage for justifying the indicators used in the measurement model that may be sufficient and reliable for deriving metrics (Burton, 2015). Cutter et al.'s (2010) Baseline Resilience Indicators for Communities (BRIC) metric has been recognized as a representative community resilience metric for comprehensively considering community dimensions, such as community capital and socioeconomic status, but the metric has a limitation with regard to undertaking validation. Without validation, it is difficult to justify resilience indices as determinants to support effective disaster management decision-making (Cai et al., 2018). Although Lam et al. (2015) recently found a validation method for resilience indices, more attention is needed to derive a validated community resilience metric that comprehensively reflects both disaster and community characteristics.

To fill these research gaps, this study attempts to adapt a validated community resilience metric that considers tourism demand as one of the main factors, and the study also applies a spatial model to identify key tourism industries that are positively associated with the validated community resilience metric across 67 counties in Florida. To achieve this purpose, a tourism community resilience measurement model is proposed and implemented via a case study of five major types of natural hazards (i.e., floods, hurricanes, storms, tornados, and wildfires) between 2010 and 2017 in Florida (Florida Division of Emergency Management, n.d.). As Florida regularly experiences natural hazards and is one of the world's top tourist destinations (Lee et al., 2020), localized and accurate community resilience metrics are needed for Florida to continuously prosper after a disaster. The findings of this study have several implications for community resilience researchers and tourism policymakers, allowing them to consider tourism demand in measuring community resilience and to utilize certain tourism industries in developing community resilience improvement strategies while considering the geographical context.

Literature review

Conceptual framework for measuring community resilience

Measuring community resilience is useful for developing effective action plans for disaster risk reduction (Cai et al., 2018) and assists in comparing levels of resilience over time and across different places (Cutter & Derakhshan, 2020). Given that unpredictable crises are threatening people and communities all around the world, the concept of resilience has been actively developed as an essential way of conceptualizing and overcoming social and health problems (Fraser et al., 1999). Specifically, the scope of such studies gradually expanded to include the ecological (Holling, 1973), physical (Gordon, 1978), psychological (Werner, 1984), community (Brown & Kulig, 1996), social (Adger, 2000), and business (Fiksel, 2006) perspectives. Remarkably, resilience studies from various fields have focused on how well individual, business, or ecological systems can bounce back to normal when disturbances occur and can even continuously prosper afterwards (Adger, 2000; Fraser et al., 1999; Holling, 1973). Within such a perspective, the concept of community resilience has been developed based on socioecological resilience (Berkes & Ross, 2013), which is defined as “a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between population or state variables” (Holling, 1973, p. 14).

Table 1 shows the conceptual development of community resilience. The definitions of community resilience that have been discussed in previous studies can be largely divided into two parts: (a) resilience as an outcome of a community or (b) resilience as a process. The former highlights the ability of a community to function and recover when disturbances occur (Adger, 2000; Foster, 2007; Walker et al., 2004), while the latter focuses on the process by which a community recovers and adapts when disturbances occur (Brown & Kulig, 1996; Magis, 2010; Norris et al., 2008). However, Cutter et al. (2014) defined community resilience as “the *de facto* framework for enhancing community-level disaster preparedness, response, and recovery” (p. 65) that focuses on both the process and outcome aspects. Recently, Lam et al. (2016) supported Cutter et al.'s (2014) definition of community resilience by noting that the concept of community resilience reflects not only the community's ability to cope with disasters but also a series of processes before, during, and after disasters. Based on prior discussions of Cutter et al. (2014) and Lam et al. (2016), this study comprehensively considers community resilience to be both an ability of a community and a process; in turn, this study defines it as the ability of a community to prepare for, respond to, and recover from disasters while mitigating future impacts.

Based on conceptual definitions, scholars have discussed the key dimensions forming the community resilience framework to precisely measure community resilience, resulting in the development of various metrics. Table 2 describes previous community resilience measurement approaches with important dimensions and indicators that can be largely divided into three parts: (a) community characteristics, such as the social and economic aspects of communities (Cutter et al., 2010; Peacock, 2010), (b) disaster characteristics, such as damage from disasters (Lam et al., 2015, 2016), and (c) the perceptions of residents (Powell et al., 2018) when constituting measurement dimensions.

Table 1
Conceptual development of community resilience.

Author	Year	Definition
Brown & Kulig	1996	A process that enhances personal and collective resilience by transforming social structures
Adger	2000	A community's capability to deal with external stresses driven by environmental, political, and social changes
Walker et al.	2004	A system's ability to absorb disturbances and retain its function, identity, and structure
Foster	2007	A region's capability to anticipate for, respond to, and recover from an event
Norris et al.	2008	A process which links a network of adaptive capacities to adaptation after a crisis
Magis	2010	A process that community members develop community resources for community prosperity in uncertain and unpredictable environments.
Cutter et al.	2014	A community's capability to get ready for, respond to, and recover from disasters
Bec et al.	2016	A community's capability to harness its resources to adapt to changes

From a community characteristics perspective, Cutter et al. (2008) proposed the "Disaster Resilience of Place" (DROP) metric as a standard metric for federal investments to reduce the vulnerability of communities. This metric has been regarded as one of the most comprehensive models that consider the complex domains of a community. Subsequently, Cutter et al. (2010) further developed the DROP metric into the BRIC metric, assuming that community resilience is a multifaceted concept and that it comprises community elements. The BRIC metric was initially developed based on a total of 36 composite indicators belonging to five domains (i.e., social, economic, community capital, infrastructural, and institutional elements); since then, this metric has been continuously modified based on 49 composite indicators belonging to six domains (i.e., social, economic, community capital, infrastructural, environmental, and institutional elements) to more precisely measure and monitor community resilience across all counties in the U.S. Meanwhile, Peacock (2010) proposed the Community Disaster Resilience Index (CDRI) to measure subresilience indices for each disaster phase (e.g., hazard mitigation and disaster preparedness) and the capital domain (e.g., social capital and human capital). Afterwards, Foster (2014) focused on metropolitan areas and developed the resilience capacity index (RCI) to compare resilience metrics between metropolitan areas. Although the four metrics described above have been applied to community policies and have been recognized as metrics that comprehensively reflect the characteristics of communities, the lack of validation of resilience metrics remains a key issue to be solved (Cai et al., 2018; Cutter & Derakhshan, 2020). Cutter and Derakhshan (2020) pointed out that the validation of metrics is an ongoing limitation for community resilience measurement studies in general.

From a disaster characteristics perspective, the "Resilience Inference Measurement" (RIM) approach proposed by Lam et al. (2016) is the most recently developed approach to overcome the prior limitation of validation. As shown in Fig. 1, the initial

Table 2
Community resilience metrics.

Metric	Author	Year	Dimensions (example indicators)
Community resilience index based on residents' perceptions	Powell et al.	2018	- Economic (job opportunities) - Social (political engagement) - Environmental (water quality)
Resilience Inference Measurement (RIM)	Lam et al.	2016	- Exposure (hazard frequency) - Damage (property damage) - Recovery (population growth)
Resilience capacity index (RCI)	Foster	2014	- Economic (household income) - Sociodemographic (age) - Community (involvement of civic organizations)
Baseline Resilience Indicators for Communities (BRIC)	Cutter et al.	2010	- Social (demographics) - Economic (median household income) - Community capital (number of civic organizations) - Infrastructural (vacant housing rates) - Institutional (hazard mitigation plans)
Community Disaster Resilience Index (CDRI)	Peacock et al.	2010	- Social capital (registered voters) - Economic capital (per capita income) - Physical capital (building construction establishments) - Human capital (health care support workers)
Disaster Resilience of Place (DROP)	Cutter et al.	2008	- Ecological (erosion rates and biodiversity) - Social (demographics) - Economic (employment and wealth generation) - Institutional (hazard mitigation plans and emergency services) - Infrastructural (transportation network) - Community competence (local understanding of risk and quality of life)

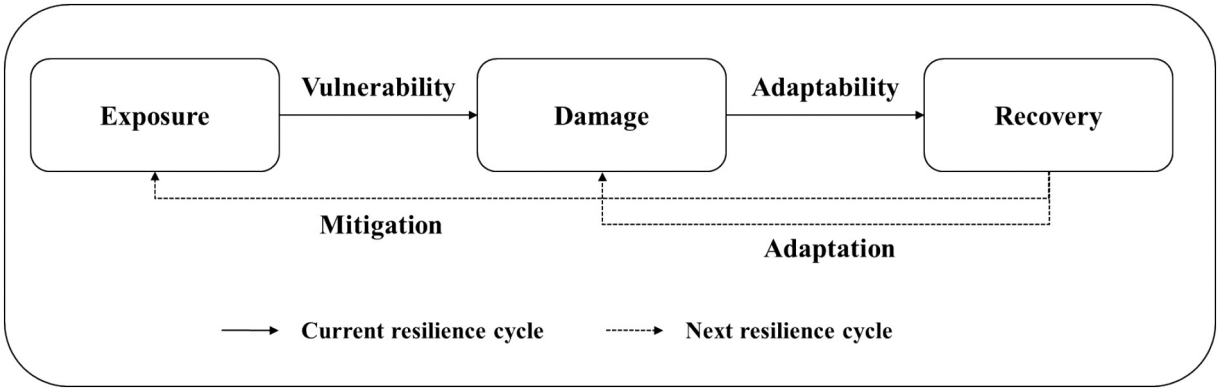

Fig. 1. Resilience Inference Measurement (RIM) framework (Lam et al., 2015).

resilience scores were calculated based on three dimensions: exposure, damage, and recovery. They were later validated by indicators related to demographic, social, economic, government, and environmental factors. Although the measurement methods for community resilience vary by study, the resilience metrics described above have the common goal of accurately measuring community disaster resilience. These metrics are measured by comprehensively reflecting the characteristics of communities formed and changed by complex indicators and the interactions among them. In measuring resilience, while a certain level of consensus has been reached in some domains (e.g., the social and economic domains), the metric outcomes have not been as consistent because the indicators within each domain have differed by the measurement metrics. Furthermore, most studies lack a validation of the indicators that were used to measure resilience (Cai et al., 2018). Resilience metric validation is required to demonstrate whether resilience indices can be reliably applied to policies and strategies related to improving community resilience.

From a perception perspective, Shao et al. (2018) stated that residents' risk perception significantly affects their capabilities to deal with disasters. They found that higher levels of community capital and economic resilience led to a higher level of risk perception of hurricanes, indicating that communities with less community capital and low economic resilience need joint efforts to increase awareness of hazard risks. Meanwhile, McEwen et al. (2017) focused on the importance of residents' flood memories in improving communities' adaptive capacity for resilience, suggesting that each community should increase social learning opportunities to share lay knowledge about hazards and to enhance community resilience.

Community resilience in tourism

Recently, community resilience has been emphasized in tourism, as resilience has great explanatory power for tourism to cope with changes (Luthe & Wyss, 2014). According to Ritchie and Jiang (2019), between 1960 and 2018, a total of 5% of all papers in tourism studies of disasters and crises focused on resilience, which means that resilience research still needs to be strengthened in the field of tourism to consider various management stages, including preparedness, response, and recovery. To date, resilience research has mainly focused on tourism enterprises or organizational resilience (Biggs, 2011; Chowdhury et al., 2018; Orchiston et al., 2016; Prayag et al., 2018), especially the resilience of the accommodation sector (Dahles & Susilowati, 2015; Sheppard & Williams, 2016) and community resilience at tourist destinations (Bec et al., 2016; Becken, 2013; Cheer et al., 2019; Guo et al., 2018; Jamaliah & Powell, 2018; Lew, 2014; Musavengane & Kloppers, 2020; Powell et al., 2018).

Previous community resilience studies in tourism have shown the importance of tourism by employing two approaches: (a) investigating the relationship between tourism and community resilience and (b) building a community resilience measurement framework. Specifically, as tourism affects multiple aspects of communities, including economic (Allen et al., 1993), sociocultural (Liu & Var, 1986), and environmental (Farrell & Runyan, 1991) development, tourism can support building community resilience to successfully respond to natural hazards (Tsai et al., 2016). Studies taking the first approach have demonstrated that communities specializing in tourism are more resilient to crises (Mazzola et al., 2019). Psycharis et al. (2014) suggested that regions in Greece specializing in tourism are more resistant to crises than regions based on manufacturing activities. Recently, Mazzola et al. (2019) and Romão (2020) have proven that tourism demand can play a pivotal role in improving community resilience. Scholars have also shown the relationship between the tourism industry and community resilience. Lee et al. (2021) found that tourism specialization, especially with respect to the accommodation and food service industries, can positively affect the economic resilience of communities and that the impact will vary by community in Florida.

Studies taking the second approach have developed community resilience frameworks by considering tourism (Bec et al., 2016; Farrell & Twining-Ward, 2004; Lew, 2014). From a theoretical perspective, Bec et al. (2016) proposed a community resilience framework to explain that tourism decline or rejuvenation (i.e., external stresses) leads to structural changes in a community and ultimately affects community resilience. Unlike previous studies that mainly used secondary data to measure resilience, Becken (2013) suggested a tourism-specific framework to measure tourist destinations' resilience by conducting interviews, describing eleven key dimensions in the social-ecological system of a tourist destination. Recently, Powell et al. (2018) measured

community resilience based on the perceptions of residents, particularly focusing on the economic, environmental, and social resilience domains. Since residents' awareness of community resilience significantly influences building community resilience, the findings can help overcome the limitations of prior studies that measured community resilience based on objective indicators. However, the weakness of measuring community resilience using survey questionnaires is that repeated surveys with the same set of indicators do not produce the same results. From a practical perspective, Filimonau and De Coteau (2020) proposed a framework to promote stakeholder collaboration and to ultimately enhance both organizational resilience and community resilience at tourist destinations. They noted that the main shortcoming of disaster preparedness in a community was the lack of collaboration between stakeholders at the disaster preparedness and recovery stages.

Although previous studies have demonstrated that tourism significantly affects community resilience, there has been a lack of research proving the role of tourism in measuring community resilience and developing resilience management strategies at the community level (Filimonau & De Coteau, 2020; Lew, 2014). A better understanding of the determinants that enhance community resilience can help the tourism industry and its communities better manage future disasters (Pyke et al., 2016). Thus, community resilience research should focus more on the role of tourism in measuring community resilience as well as the impact of the tourism industry on community resilience. The analyses conducted here are novel in that they demonstrate the role of tourism in measuring and improving community resilience.

Methods

Study area and variables

We selected the state of Florida as the study area for two reasons. First, Florida is one of the world's top tourist destinations. According to Visit Florida (2019), the number of visitors has grown steadily, with approximately 127 million visitors visiting the state in 2018 and approximately 131.4 million visitors visiting Florida in 2019. As Florida is endowed with abundant tourism resources, such as beaches and theme parks, it was the second most visited state in the U.S. after California (World Facts, 2018). Second, Florida experiences natural hazards on a regular basis. Florida's residents and visitors experience a large array of natural hazards, including hurricanes and floods, every year (Florida Disasters, n.d.). Thus, to quickly recover from disasters and to continuously prosper afterwards, communities in Florida need a more customized resilience measurement model that reflects not only natural hazards that cause severe damage but also the characteristics of tourism communities. Fig. 2 shows the county

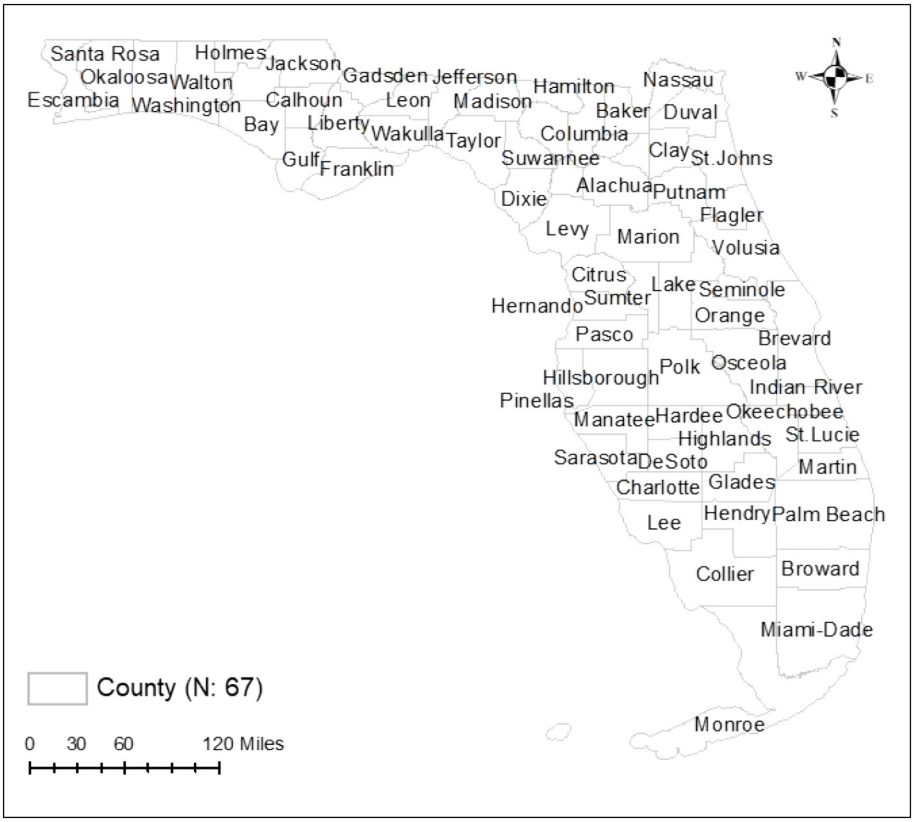

Fig. 2. Study area.

boundaries in Florida. In this study, the unit of analysis is the county, which is the most commonly used unit in previous studies (Cutter & Derakhshan, 2020) and one of the most important geographical units for local policies (Kim et al., 2018).

To develop a validated tourism community resilience metric, both the RIM framework (Lam et al., 2015) and the BRIC approach (Cutter et al., 2010) were employed. The RIM framework mainly considers disaster characteristics and proposes the validation process, while the BRIC approach comprehensively considers the dimensions of community resilience. Thus, an initial community resilience status for each community can be measured based on the RIM framework and can be validated through the BRIC approach. First, the RIM framework includes the dimensions of exposure, property damage, and recovery. The exposure dimension represents two variables: (1) hazard frequency and (2) hazard duration. The damage dimension includes the property damage variable. The recovery dimension represents the variables of population growth during the study period. According to Lam et al. (2015), population changes over time reflect whether individuals or businesses decide to remain in or move away from a community after crises, but this dimension still has a limitation in fully reflecting recovery from disasters. Specifically, as the tourism industry is a top economic driver in Florida, tourism significantly contributes to economic prosperity, which provides the foundation for community development (Crouch & Ritchie, 1999). Thus, we considered tourism growth, which is represented by the tourism tax variable, as one of the elements in the recovery dimension (Shahzad et al., 2017). Furthermore, in addition to the property damage variable, we considered the casualty dimension, including variables of fatalities and injuries, as damage includes not only property damage but also injury and death (Holle et al., 2005). The variables and their operational indicators used in measuring initial community resilience are shown in Table 3.

For validation, variables should not be used in the initial resilience measurement stage; rather, they should represent community resilience. The BRIC metric considers five broad categories (i.e., the infrastructural, economic, community capital, institutional, and social dimensions) of community resilience at the county level (Cutter et al., 2010). Thus, based on the BRIC approach, this study considered comprehensive variables that represent five dimensions of community resilience. In particular, this study added the tourism dimension to investigate whether tourism demand plays a significant role in building community resilience. According to Mazzola et al. (2019), tourism demand is significant for improving resilience, as an increase in tourism demand leads to economic growth (Schubert et al., 2011), which is a key factor in building community resilience. The tourism dimension includes Airbnb bookings (Volgger et al., 2019), hotel bookings (Pan & Yang, 2016), Airbnb/hotel operational performance (Dogru et al., 2020), and reviews of attractions in TripAdvisor (Colladon et al., 2019). As a result, a total of 33 comprehensive community variables were used to validate the initial community resilience metric (see Table 4).

To explore the spatially varying relationships between the validated community resilience metric and different tourism industries, five types of tourism industries were defined according to North American Industry Classification System (NAICS) codes–711 (performing arts and spectator sports), 712 (museums, historical sites, zoos, and parks), 713 (amusements, gambling, and recreation), 721 (accommodation), and 722 (food services and drinking places). This classification of the tourism industry is based on the previous study by Lee et al. (2021). To measure the degree of tourism industry concentration, this study used the averages of the three-year (2015–2017) tourism industry location quotients (LQs), which represent the relative concentration of each tourism industry in a county compared to the U.S. average (Lee et al., 2021). The three-year average tourism industry LQs were calculated as follows:

$$\mathrm{AveLQ}_{tc} = \mathrm{Ave}\frac{S_{tc}}{S_{kc}} = \frac{\sum_{i=2015}^{2017}\frac{N_{tci}}{N_{ti}}}{3\sum_{i=2015}^{2017}\frac{N_{kci}}{N_{ki}}}$$

where N_{tci} represents the number of workers in tourism industry t in county c in year i; N_{ti} represents the number of workers in tourism industry t in all counties in Florida in year i; N_{kci} is the number of workers in all industries in county c in year i; and N_{ki} represents the number of workers in the entire U.S. economy k in year i. If a value of LQ_{rc} is greater than 1, the number of employees in a county

Table 3
Dimensions and indicators used for measuring community resilience.

Dimension	Variable	Indicator	Reference (year)	Source
Exposure	Hazard frequency	Number of times each county was hit by natural hazards	Lam et al. (2015)	SHELDUS
	Hazard duration	Length of the event expressed in number of days		
Damage	Property damage	Direct damage to property in adjusted U.S. dollars (base: 2017) divided by annual county gross domestic product GDP ($)	Ash et al. (2013)	SHELDUS & Bureau of Economic Analysis
Casualties	Fatalities	Number of people killed/divided by the annual county population		SHELDUS
	Injuries	Number of people injured/divided by the annual county population		
Recovery	Population growth	Population growth rate between 2010 and 2017	Lam et al. (2015)	U.S. Census Bureau
	Tourism growth	Tourist tax growth rate between 2010 and 2017		Florida Department of Revenue

Note: SHELDUS: Spatial Hazard Events and Losses Database for the United States.

Table 4
Dimensions and indicators used for validation.

Dimension	Indicator	Reference (year)	Source
Social	% population below 65	Cutter et al. (2010)	USCB
	% population proficient English speakers	Cutter et al. (2010)	
	Population density	Ryu et al. (2011)	
	% households with at least one vehicle	Cutter et al. (2010)	
	% housing units with telephone service available	Cutter et al. (2010)	
	Absolute difference between % population over 25 with college education and % population over 25 with less than high school education (inverted)	Cutter et al. (2010)	
	% pop without disability	Cutter et al. (2010)	
	% population under age 65 with health insurance coverage	Cutter et al. (2010)	
Economic	% labor force employed	Cutter et al. (2014)	
	% labor force employed by federal government	Cutter et al. (2014)	
	% population not living in poverty	Cutter et al. (2014)	
	Absolute difference between male and female median income (inverted)	Cutter et al. (2014)	
	Median household income	Sherrieb et al. (2010)	
	% owner occupied housing units	Cutter & Derakhshan (2020)	
	Per capita income	Lam et al. (2015)	
	% population not employed in farming, fishing, forestry, and extractive industries	Cutter et al. (2010)	
	Gini coefficient	Cutter & Derakhshan (2020)	
Infrastructure	% housing units not mobile homes	Cutter et al. (2010)	USCB
	Vacant housing rates that are for rent	Cutter et al. (2014)	
	% housing units built after 2000	Cutter & Derakhshan (2020)	
	Total length of roads per sq. mile	Cutter et al. (2010)	FDOT
	Health care facility per 1000 pop	Coles & Buckle (2004)	USCB
	Number of schools per 10,000	Cutter et al. (2010)	
Community capital	% population born in the current state of residence	Norris et al. (2008)	USCB
	Number of religious organizations per 10,000 population	Cutter et al. (2010)	ARDA
	Number of civic and social organizations per 10,000 population		USCB
Institutional	% population covered by a hazard mitigation plan	Cutter et al. (2010)	FEMA
	% housing units covered by National Flood Insurance Program		
	Crop insurance payment per capita		SHELDUS
Tourism demand	Hotel RevPar		DEO
	Hotel room demand		
	Airbnb RevPar		
	Airbnb number of bookings		
	Number of reviews of attractions		

Note: ARDA: Association of Religion Data Archives; DEO: Department of Economic Opportunity; FDOT: Florida Department of Transportation; FEMA: Federal Emergency Management Agency; NAICS: North American Industry Classification System; USCB: U.S. Census Bureau.

for a given industry S_{tc} is greater than the U.S. average, indicating industrial concentration. Table 5 summarizes the tourism industry variables and their operational definitions.

Data analysis

The proposed tourism community resilience measurement model includes four steps. Fig. 3 shows the methodological flowchart.

Table 5
Tourism industry variables for geographically weighted regression analysis.

Category	Variable	Operational definition	Source
Tourism attraction complexes (arts/entertainment/ recreation)	LQ711	The three-year (2015–2017) average LQ of performing arts/spectator sports	DEO
	LQ712	The three-year (2015–2017) average LQ of museums/ historical sites/zoos/parks	
Tourism service components (accommodation/food services)	LQ713	The three-year (2015–2017) average LQ of amusements/gambling/recreation	
	LQ721	The three-year (2015–2017) average LQ of accommodation	
	LQ722	The three-year (2015–2017) average LQ of food services/drinking places	

Note: DEP: Department of Economic Opportunity; LQ: location quotient; NAICS: The North American Industry Classification System.

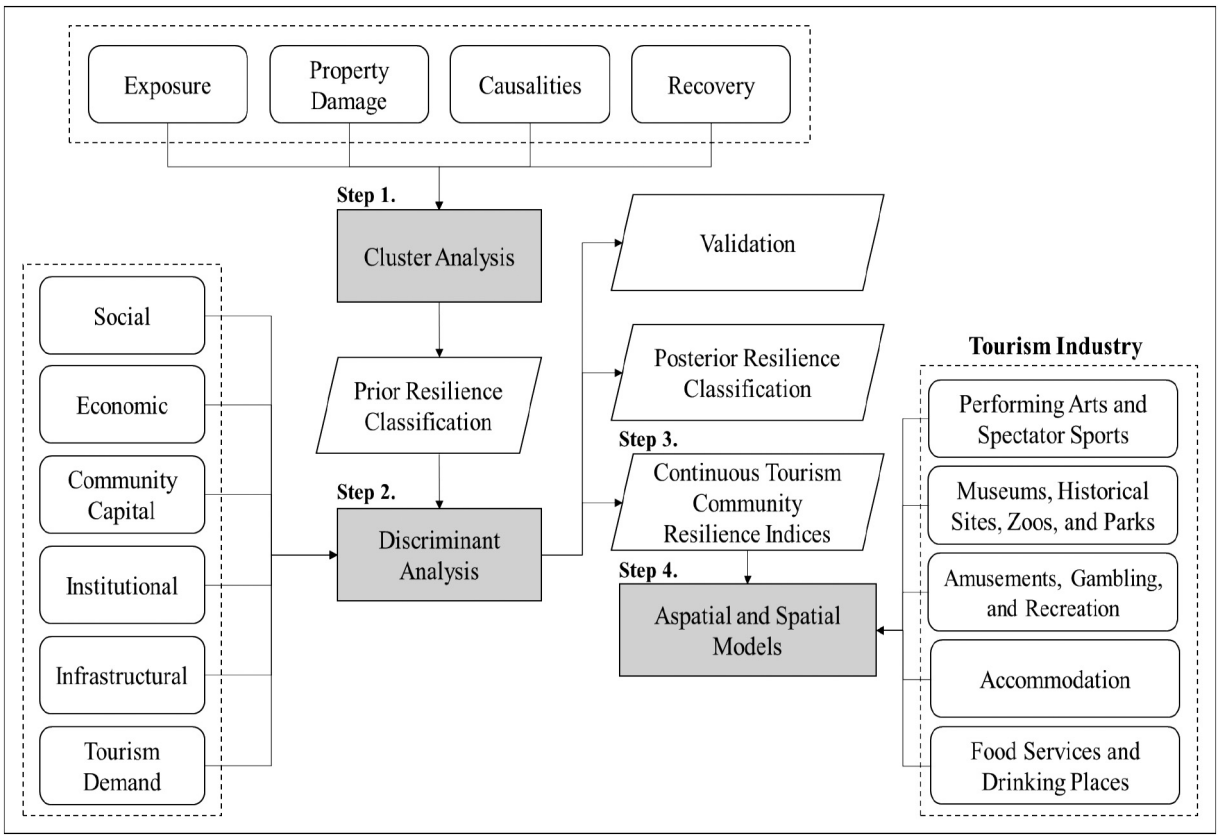

Fig. 3. Methodological flowchart.

The first step is to classify the community resilience levels by the exposure, property damage, casualty, and recovery dimensions based on the RIM approach of Lam et al. (2016). K-means analysis was employed for classification. The second step is to validate the measurement metrics resulting from the first step. Stepwise discriminant analysis, using 33 community variables that make up six dimensions, was employed based on the BRIC approach of Cutter et al. (2010). K-means and discriminant analyses were processed using SPSS (version 26). The third step is to calculate a continuous resilience metric. This metric was computed based on the probabilities of each community belonging to a particular resilience level (Lam et al., 2016). The equation used in this step was as follows:

$$\text{Resilience Score} = \sum_{p=1}^{t} r \times \text{Prob}\,(r)$$

where p is the cluster ranking of resilience, which is the result of K-means analysis; t is the number of resilience levels; and Prob (r) is the probability of each county belonging to a specific resilience level r. The last step is to explore the spatially varying relationships between the measured community resilience metric from the previous step and different types of tourism industries. Before exploring the spatial variability between them, aspatial regression analysis using ordinary least squares (OLS) was conducted to identify key tourism industries that are associated with the measured community resilience metric by examining the global relationship between variables. The suggested aspatial OLS regression model was applied as follows:

$$\text{Resilience}_i = \beta_0 + \beta_k \text{Tourism}_k + \varepsilon$$

where Resilience_i refers to the community resilience metric of county i; β_0 is the intercept parameter; β_k is the regression coefficient for tourism industry k; and Tourism_k is the three-year average LQ of tourism industry k.

After estimating the aspatial relationship between community resilience and tourism industries, a spatial regression model using geographically weighted regression (GWR) analysis was employed to explore the important local variations in the

association between variables. As a spatially explicit analysis, GWR assumes that the relationships between variables may differ from location to location (Lu et al., 2014).

$$\text{Resilience}_c = \beta_{c0}(\text{lon}_c, \text{lat}_c) + \beta_{ct}(u_c, v_c)\text{Tourism}_{ck} + \varepsilon_c$$

where Resilience_c refers to the community resilience metric of county c; $(\text{lon}_c, \text{lat}_c)$ is the longitude and latitude coordinates for the county c centroid; and $\beta_{ct}(\text{lon}_c, \text{lat}_c)$ is the local regression coefficient for tourism industry t of county c. A bisquare kernel function was applied to consider the different sizes of counties in Florida (Fotheringham et al., 1998) and to determine the optimized number of neighbors used to maximize the model fit. The spatial weight (W_{ak}) for the bisquare kernel function was calculated as follows:

$$W_{ak} = \left[1 - \left(d_{ak}/t^2\right)\right] \text{ when } d_{ak} \le t, W_{ak} = 0 \text{ when } d_{ak} > t$$

where d_{ak} is the Euclidean distance from regression point a and property k and t is the bandwidth. Iterative statistical optimization was applied to mitigate the corrected Akaike information criterion (AIC_c). Both OLS and GWR were conducted through ArcGIS 10.7.1.

Results

Measurement of the community resilience metric

In the first step, in which the initial resilience groups are derived through K-means clustering, four levels (i.e., usurper, recovering, resistant, and susceptible) of resilience groups from high to low resiliency were derived based on Lam et al. (2016). Fig. 4-a shows the results. Specifically, one county (Orange County) was a usurper community that can not only resist a disturbance but also prosper afterwards; 58 counties were recovering communities with a below average exposure and damage status and a slightly above average recovery status; four counties (Highlands, Okeechobee, St. Johns, and Dixie Counties) were resistant communities with low vulnerability and average adaptability; and four counties (Bay, Flagler, Monroe, and Gulf Counties) were susceptible communities that encountered severe damage and could not fully recover after disturbances (Lam et al., 2016). The findings show that the community resilience of each county can be categorized by the exposure, property damage, casualty, and recovery dimensions.

In the second step, the resilience metrics derived from the first step were validated through the composite indicators described in Table 4. As a result of discriminant analysis, 88.06% of counties were correctly classified. In other words, 59 out of 67 counties were correctly classified (Fig. 4-b). The results cross-validated all four composite indicators used for K-means analysis and all six composite dimensions used for discriminant analysis. Specifically, one county (Orange) was clustered into the usurper level; 58 were classified as recovering; nine counties were at the resistant level; and five counties (Bay, Flagler, Monroe, Franklin, and Gulf) were at the susceptible level. These results demonstrate the utility of the proposed tourism community resilience measurement model.

The third step is to calculate a continuous resilience score based on the probabilities of each county belonging to a particular resilience group. The validated resilience metrics are visualized in Fig. 4-c. As shown in the map, most counties showed above average resilience scores (2.78), while some counties in the central and northern regions of Florida showed below- or near-average resilience scores. For example, Orange County showed the highest community resilience score, while Gulf, Franklin, and Monroe Counties, which are located in northwestern and southern Florida, showed the lowest resilience scores. These findings show spatial variability in the level of the validated community resilience metric across 67 counties in Florida.

The relationship between community resilience and tourism industries

Table 6 summarizes the results of the OLS and GWR models. The OLS regression results revealed that all tourism industries except for LQ721 (accommodation) were statistically significant. Specifically, based on the regression coefficients, LQ711 (performing arts/spectator sports) and LQ713 (amusements/gambling/recreation) were positively related to community resilience, while LQ712 (museums/historical sites/zoos/parks) and LQ722 (food services/drinking places) were negatively related to community resilience. These results mean that industries related to performing arts, spectator sports, amusements, gambling, and recreations are key tourism industries that are positively related to community resilience.

Regarding the GWR model, the local R^2 values ranged from a minimum of 0.22 to a maximum of 0.91, with a mean of 0.49. The spatial autocorrelation of the residuals (Moran's I: 0.05, p-value: 0.36) and the local condition metric (from 7.99 to 8.01) within a threshold of 30 represent spatial randomness and the appropriateness of running a GWR model, as there is no local collinearity issue. The local coefficients of each tourism industry ranged from 0.08 to 2.79, with a mean of 0.26 (LQ711: performing arts/spectator sports); from −1.75 to −0.15, with a mean of −0.33 (LQ712: museums/historical sites/zoos/parks); from 0.07 to 0.62, with a mean of 0.18 (LQ713: amusements/gambling/recreation); from −0.02 to 0.19, with a mean of 0.04 (LQ721: accommodation); and from −0.60 to −0.22, with a mean of −0.33 (LQ722: food services/drinking places). Specifically, based on the average local coefficients, LQs711 (performing arts/spectator sports), 713 (amusements/gambling/recreation), and 721 (accommodation) showed positive local coefficients, indicating that these industries are key tourism industries that enhance community resilience. Fig. 5 shows maps of the spatial distribution of the local coefficients and R^2 for tourism industries. In particular, LQ721

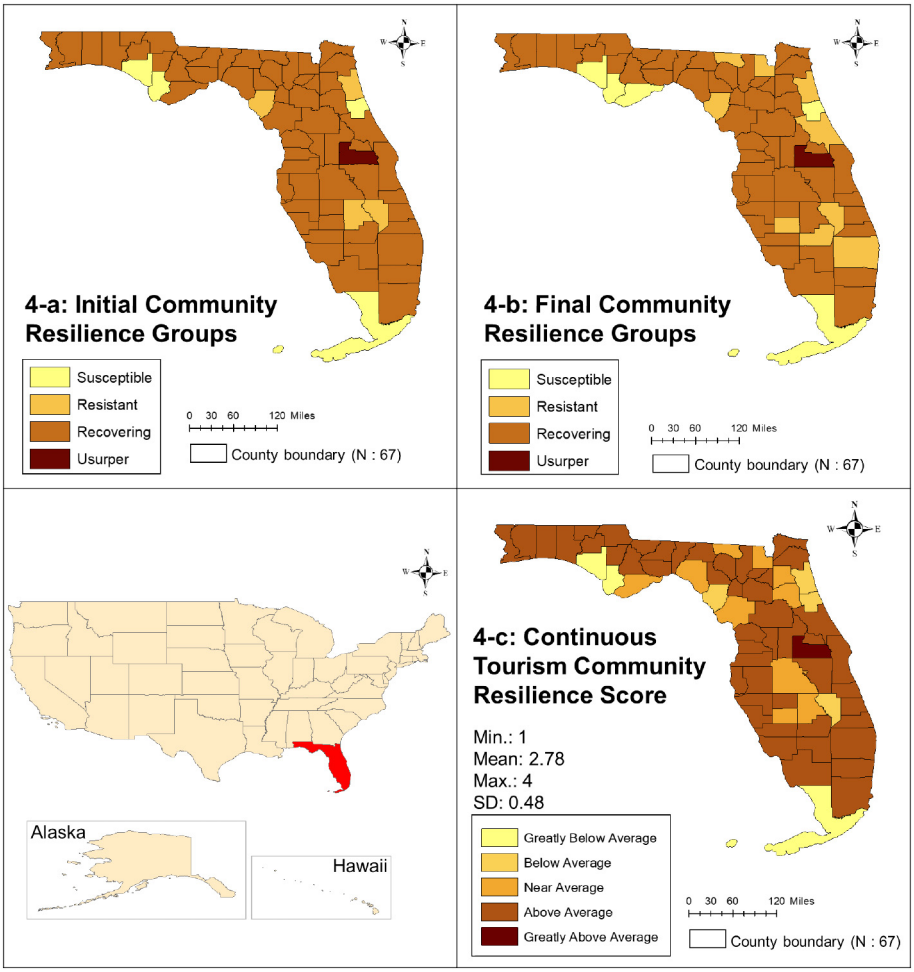

Fig. 4. Spatial distribution of a community resilience score.

(Accommodation) has mixed effects – positive local coefficients in northern Florida and negative local coefficients in southern Florida – on community resilience. LQs711 (Performing arts/spectator sports) and 713 (Amusements/gambling/recreation) have positive local coefficients for all counties. In particular, higher local coefficients were observed in northwest areas (LQs711 and 713), while lower coefficients were located in central and southern areas (LQ711). Such variability in the local coefficients shows the spatially heterogeneous associations between community resilience and tourism industries across counties in Florida, as each county has unique characteristics.

Table 6
Results of OLS and GWR models.

Variable	OLS	GWR coefficient (β)		
	β	Min.	Mean	Max.
Intercept	2.98**	2.89	2.98	3.11
LQ711 (performing arts/spectator sports)	0.13*	0.08	0.26	2.79
LQ712 (museums/historical sites/zoos/parks)	−0.23**	−1.75	−0.33	−0.15
LQ713 (amusements/gambling/recreation)	0.15**	0.07	0.18	0.62
LQ721 (accommodation)	0.02	−0.02	0.04	0.19
LQ722 (food services/drinking places)	−0.30*	−0.60	−0.33	−0.22
Local R^2	0.43	0.22	0.49	0.91
Adjusted R^2	0.38		0.49	
AIC_c	70.31		69.38	

Note: AIC_c: corrected Akaike's information criterion; LQ: location quotient; NAICS: The North American Industry Classification System; Max.: maximum; Min.: minimum.
** $p < 0.01$.
* $p < 0.05$.

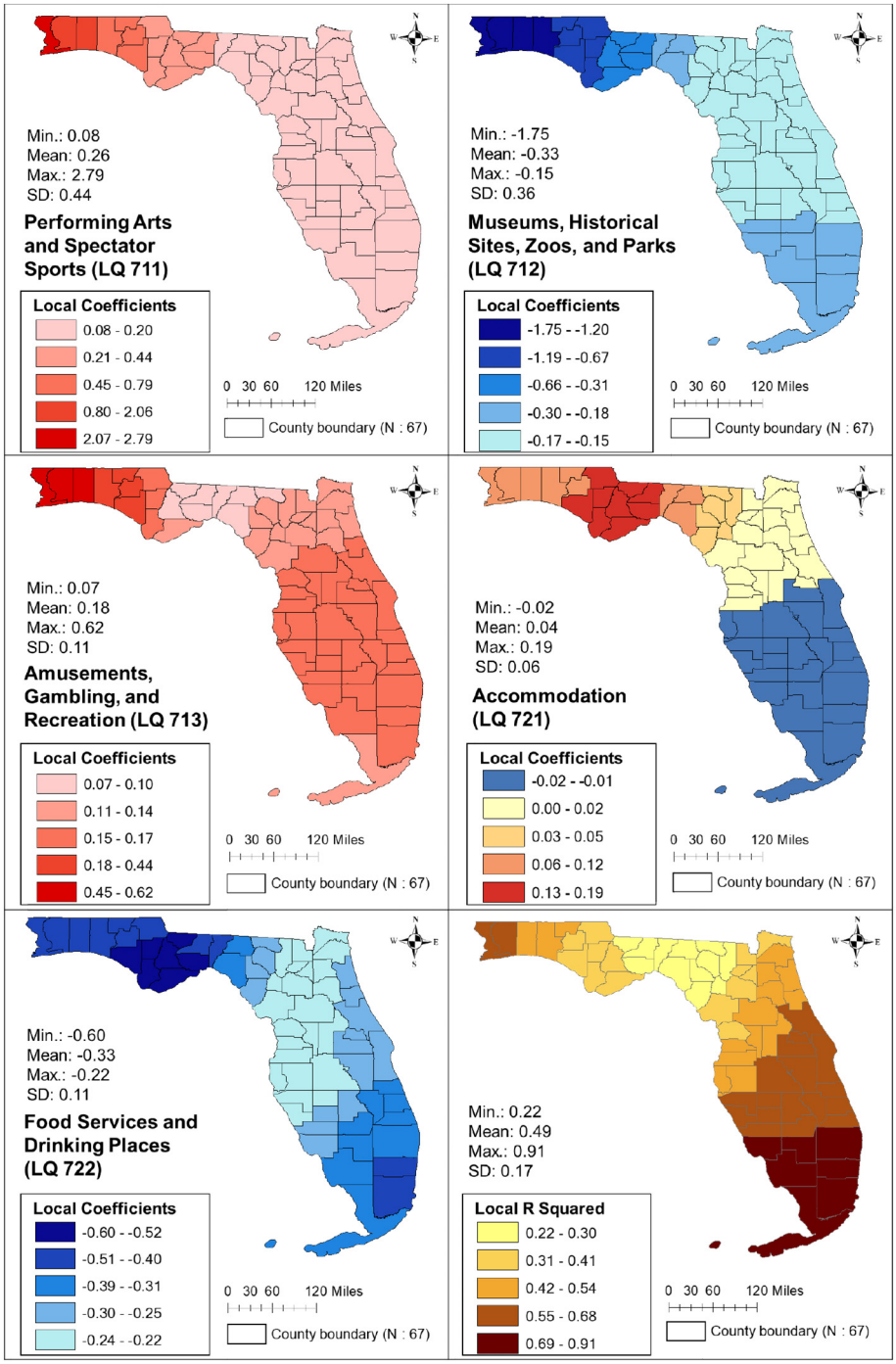

Fig. 5. Spatial distribution of local coefficients and local R^2.

Discussion and implications

Based on the concept of community resilience, the findings of this study expand the resilience literature in tourism by proposing (1) a tourism community resilience measurement framework and (2) key tourism industries that are positively associated with community resilience across 67 counties in Florida. The findings prove that tourism demand plays an important role in measuring community resilience. Furthermore, through the use of aspatial and spatial models, the findings show the spatially varying relationship between tourism industries and the validated community resilience metric and determine the main tourism industries for improving community resilience. This regional approach, which provides a basis for localized and tourism

industry-focused community resilience strategies, responds to prior limitations with respect to the lack of framework testing and disaster planning research in tourism (Ritchie & Jiang, 2019).

As empirically demonstrated above, the tourism demand dimension plays a significant role in measuring community resilience. This finding is in line with prior studies showing that tourism has the potential to improve community resilience by building the community capacity to undertake an adaptive response to disasters (Tsai et al., 2016). Specifically, an increase in tourism demand leads to economic growth (Romão, 2020), which is an essential factor in building community resilience (Cutter et al., 2010). Furthermore, there are differences in the relationship between community resilience and tourism industries based on location and the tourism industry type. These findings can be described by the fact that each county has its own unique characteristics that may form community resilience differently and by the fact that community resilience is significantly affected by the main industry of the community (Psycharis et al., 2014). In particular, certain tourism industries (e.g., food services and drinking places) were negatively associated with community resilience, indicating that there might be the potential negative impact of tourism industries on community resilience due to overspecialization. These findings could be understood with an examination of regional disparities in the level of community carrying capacity that may affect regional socioeconomic/physical environments and visitors' quality of satisfaction/experience (Clark, 1997; Swarbrooke, 1999). For example, the accommodation industry (LQ721) may positively support the economic carrying capacity of northern counties, including higher income and labor force, which supports community resilience. However, the accommodation sector specialization negatively affects the social and biophysical carrying capacity of southern counties, including environmental degradation, which results in decreasing community resilience.

Theoretical implications

Theoretically, this study extends the scope of research on community resilience by proving the significance of the tourism dimension in measuring community resilience. Numerous discussions on measuring community resilience in the literature have shown significant consensus on the nature of community resilience (Greene et al., 2004). Specifically, prior studies have focused on comprehensively reflecting significant dimensions that form community resilience, such as the social, economic, and exposure dimensions (Cutter et al., 2010; Powell et al., 2018), and validating the metrics (Lam et al., 2016). Although scholars have demonstrated that tourism plays a significant role in forming community resilience (Ruiz-Ballesteros, 2011), prior studies have barely considered tourism as a key dimension in measuring community resilience. By integrating two representative measurement frameworks, the RIM and BRIC approaches, this study not only develops a validated community resilience metric but also proves the significance of the tourism dimension in measuring community resilience metrics. More specifically, this study derives a community resilience metric based on disaster-related dimensions, such as exposure to disasters, property damage, casualties, and recovery from disasters, and it validates this metric based on comprehensive community dimensions, such as the socioeconomic and tourism dimensions. The dimensions and indicators used in this study reinforce the elements of the RIM approach, and the validated measurement model of this study supplements the validation issue of the BRIC approach. The proposed tourism community resilience measurement model may help researchers understand the significance of tourism demand in measuring community resilience and apply the model to measure the resilience of various tourism-dependent communities.

Furthermore, our findings offer new insights into the relationship between community resilience and tourism by exploring the spatially negative and positive effects of tourism on community resilience. Although prior studies have highlighted that tourism can enhance community resilience by supporting the economic aspect of a community (Lee et al., 2021), our findings reinforce their arguments and call for more investigation of community carrying capacity, which both directly and indirectly affects community resilience. In addition, the findings still require additional quantitative and qualitative studies to examine key determinants that explain how and why spatial variability in tourism occurs.

Practical implications

The practical application of resilience research has been increasingly highlighted and to date, only 8 out of 174 articles related to community resilience published between 2005 and 2017 proposed practical strategies (Cai et al., 2018). This situation means that research has yielded an insufficient number of practical implications with regard to the practical application of research findings (Filimonau & De Coteau, 2020). The findings of this study provide several significant implications for tourism practitioners and policymakers in developing localized and tourism-focused resilience enhancement strategies. From the community policy perspective, this study proposes that policymakers need to take full advantage of the benefits of tourism industries in improving community resilience, especially in tourism-dependent communities. The findings offer empirical evidence that certain tourism industries are significant for enhancing community resilience and that the relationship between community resilience and tourism industries varies by county. These findings propose localized community resilience enhancement strategies that consider tourism. For example, northwestern Florida counties (e.g., Okaloosa, Walton, and Bay Counties) can choose perhaps one or two among the performing arts, spectator sports, amusements, gambling, recreation, and accommodation industries to improve community resilience. As each locality will desire to preserve the uniqueness of their local tourism-related activities and industries, community and industry leaders should choose carefully in tourism development to grow in ways that complement local strengths and character.

From the tourism industry perspective, the outcomes of this study show that the same types of tourism industries can have different impacts on community resilience, and this study identifies certain tourism industries across counties in Florida that make a community more resilient. As shown in Fig. 6, this study suggests that there are community resilience clusters and

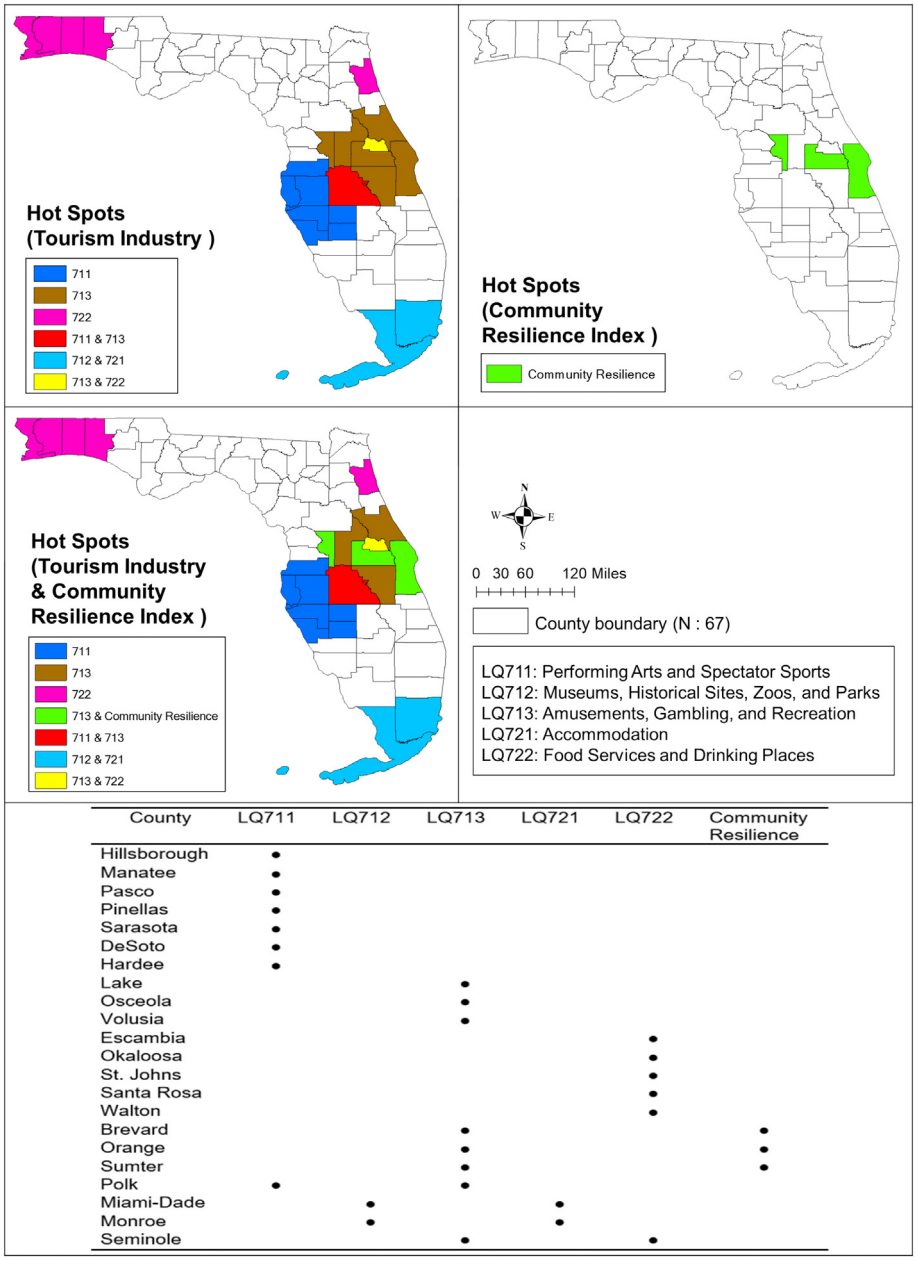

Fig. 6. Hot spot counties.

tourism industry clusters, proposing that tourism stakeholders can cooperate to make tourism industries more specialized in Florida to improve both the tourism industry and community resilience. Specifically, LQ711 (performing arts/spectator sports) and LQ713 (amusements/gambling/recreation) are key determinants that can enhance community resilience (see Table 6), and community resilience clusters overlap with LQ713 (amusements/gambling/recreation) clusters. These findings mean that counties (i.e., Brevard, Orange, and Sumter Counties) within spatially overlapping clusters can serve as a basis for developing amusements, gambling, and recreation industries. According to Mazzola et al. (2019), local development is significantly dependent on tourism. Tourism has a place in diversifying and strengthening the economy and infrastructure across counties in Florida, indicating that tourism development can be one of the main policy options to recover from and prosper after disasters. Specifically, these localized strategies support effective regional policies within a political geographic unit by identifying key determinants that improve resilience and the possibility of cooperation between communities. Tourism industry specialization is also an opportunity for both local residents and businesses to increase income, employment, and infrastructure, as local tourism industries are important to the local economy in terms of creating jobs and providing customers for other firms (Dahles & Susilowati, 2015).

Limitations and future research directions

Despite the significant implications discussed above, some limitations are identified. First, the indicators this study used to measure community resilience are limited to objective indicators such as the proportion of the population living in poverty and tourism taxes. Subjective characteristics of communities, such as the level of residents' and local companies' perceptions of community resilience or their willingness to participate in the recovery process after disasters, also critically affect the construction of community resilience. According to Ainuddin and Routray (2012), residents' awareness and preparedness have a significant impact on building community resilience. Thus, future research can collect data to consider the subjective features of communities, leading to a more comprehensively measured community resilience metric. Second, the findings are limited to Florida. Although this study demonstrated that tourism demand is a significant factor when measuring community resilience and included tourism-related indicators in its resilience measurement model, the proposed model should be tested in other communities where the tourism industry is not a main industry. Furthermore, by using a geographical approach (e.g., GWR used in this study), which can consider each community's unique characteristics and spatial effects, the spatially heterogeneous impacts of tourism industries on community resilience should be measured to identify the mixed (positive and/or negative) effects of tourism industries across different communities. Depending on the features of communities, tourism may or may not play a significant role in forming community resilience. Third, the geographic unit of analysis (counties) did not allow more detailed and nuanced investigation of more local relationships between the resilience metric and tourism industries, such as at the municipal level or zip code. Similarly, the use of the three digit NAICS codes did not allow for a more nuanced analysis of how more specific tourism industries are differently associated with economic resilience. Finally, this study measured a static community resilience score that represents a snapshot of the resilience status and does not show dynamic changes in community resilience over time. To effectively develop community resilience enhancement policies, future studies can develop a dynamic community resilience simulation model that reflects continuous changes in and interactions among resilience indicators.

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