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Sense of place and micro-business vulnerability to extreme weather in China

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ABSTRACT

Micro-businesses are highly vulnerable to the impact of extreme weather. However, business and management research has primarily focused on larger organizations or tended to rely on evidence from developed countries. The concept of place is reduced to physical location and space. This research explores the role of a broader concept of place that encompasses sensemaking. The objective is to examine the relationship between sense of place and the vulnerable characteristics of business. Structured interviews were conducted with 300 owners and operators of micro-businesses operating in three Chinese coastal cities. Results have identified multiple linkages between attributes of sense of place and business vulnerability. While these linkages do not demonstrate complete coherence, place identity shows the strongest explanatory power. New directions for future research are discussed, concerning the multidimensionality of the concept of place beyond materiality and spatiality, and the dynamic relationship between place and vulnerability accumulation.

1. Introduction

Extreme weather events induced by climate change, such as storms and flooding, can significantly impact businesses. However, as Crick et al (2018b) have pointed out, scholarly research and discussions about business response to extreme weather have focused on larger organizations and developed countries (Averchenkova et al., 2016; Berkhout, 2012; Berkhout et al., 2006; Herrmann and Guenther, 2017; Linnenluecke et al., 2013). This stands at odds with the fact that small and micro-entreprises dominate the entreprise landscape and are more vulnerable to climate change impacts than the larger ones, especially in developing countries.

In the U.S, 69 % of all business establishments have less than 20 employees, although they contribute to only 16 % of employment across the country (U.S. Census Bureau, 2022). The dominance of micro-businesses is more evident in developing countries. In China, for instance, 85.3 % of all business entities are classified as micro-businesses.[1] Despite their low turnover, these micro-businesses contribute to 22.6 % of employment in China, rising to 56.4 % if small businesses are included (National Bureau of Statistics, 2020). Small and medium-sized entreprises (SMEs) account for an even larger proportion of employment in Africa (Crick et al., 2018b).

Smaller businesses are vulnerable to adversity in the environment. Equitable climate resilient development requires efforts to enable them to cope with the consequences of climate change and adapt to long-term impacts (Crick et al., 2018a). A better understanding of their vulnerability is essential to overcoming the challenges brought by climate change. There is an increasing amount of evidence about the vulnerability and response of smaller businesses to extreme weather events. However, few studies have addressed the geography of business beyond physical location.

Linnenluecke and Griffiths (2015) argue that business research often overlooks the concept of *place*, which encompasses physical location and meaning assigned by people. This view resonates to Shrivastava and Kennelly's (2013) and Guthey et al.'s (2014) critique of 'placeless' entreprise sustainability research. However, the scope of their critique is confined to sustainability. Moreover, value creation is often the main focus of organizational research that engages the concept of place (Di

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[1] There is no single definition of micro-business, which varies geographically and across sector. For example, the International Finance Corporation (2013) defines micro-businesses as those with less than 5 employees, whereas in the U.K, a micro-business has fewer than 10 employees. In China, the official classification threshold levels are sector-specific. However, for most sectors, including retail and manufacturing, having less than 10 or 20 employees is one of the criteria for defining a micro-business (National Bureau of Statistics, 2018).

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Gregorio, 2017; Hanlon, 2001; Thomas et al., 2008; Zaheer and Nachum, 2011). There is an analytical tendency for conceptualizing businesses, particularly the larger ones, as agents of change in climate change adaptation, such as being innovators, resource providers, and problem solvers (Averchenkova et al, 2016; Crick et al., 2018a). Despite being one of the most fragile economic entities, micro-businesses have received disproportionately less attention.

Few studies have mobilized the concept of place to understand small-business vulnerability. Some of them have identified issues of concern for management theory and practice. Marshall et al. (2012), for example, show that place attachment can be a perverse driver of vulnerability. Organizational decision-makers who are highly attached to their place are less willing to consider or undertake changes that involve moving locations as a response to local water stress (Marshall et al., 2012). Therefore, we argue that the marginality of the concept of place constitutes a limitation of management research in the context of global climate change. To reduce the vulnerability of smaller businesses, there is a need for recognizing how decision-makers' sensitivity to extreme weather and their response capacities are contextualized in place and constructed across scale.

Our study addresses the placelessness of business research, while representing a constructive departure from Shrivastava and Kennelly (2013) and Guthey et al. (2014) by exploring an alternative framing of place in terms of vulnerability. It aims to explore the role of sense of place in the study of smaller businesses that are exposed to the direct impacts of climate change. The exploratory study involves a structured analysis of the relationship between sense of place and resilience of the most vulnerable group (i.e., micro-businesses located in hazard-prone areas). It contributes to knowledge by advancing the notion of 'vulnerability *with* place', which suggests that vulnerability does not only stem from being in a given physical location, but is also interdependent on place and the making sense of place.

Evidence was solicited from three coastal cities in southern China, namely, Sanya, Zhuhai, and Macau. All of the study areas are tourist destinations and exposed to flooding or storms, but there are substantial differences in the ways in which people make sense of the place and their vulnerability to flooding/storm impacts. Some of those living in a remote lifestyle community tend to see the place as home, a way of sensemaking less common among those struggling to survive in a more competitive tourism city. Some of the micro-businesses have been coping with peripherality and extreme weather, whereas others are better off and protected. These differences provide a high degree of empirical variability, which is useful for testing the place-vulnerability relationship and for drawing lessons for a wider range of locations with different socio-demographic characteristics and development trajectories. Our study involved structured interviews with 300 micro-business owners and operators in the retail trade and hospitality sectors with fewer than five employees. Statistical analysis was performed to ascertain how sense of place is related to sources of business vulnerability.

2. Literature review

2.1. Business vulnerability to extreme weather

Larger business organizations have a greater capacity to cope with extreme weather events. They can afford to invest in resilient infrastructure, disaster risk analysis, comprehensive risk management plans, insurance, and disaster recovery measures. Leading organizations can support societal adaptation to long-term climate change impacts by providing resources, sharing the best organizational practice, and driving supply-chain transitions (Averchenkova et al, 2016; Linnenluecke and Griffiths, 2015). However, the private sector is not a homogenous entity, and the capacity of small businesses to respond is much more limited than the larger ones (Crick et al., 2018a).

The higher vulnerability of small businesses stems from their lower profits and cash reserves, geographical concentration of business operations and inventories, heavy reliance on local customer bases, and limited technical and managerial capabilities for developing and executing hazard management programs (Tierney, 2007; Zhang et al., 2009). Small businesses therefore exhibit diminished capacity to address extended shutdowns, mechanical failures, employee absences, disruptions in vital services and supplies, telecommunication outages, property damage, and escalating insurance expenses (Crichton, 2006; Reynolds, 2013).

Research has documented a variety of factors that determine their vulnerability, such as location, sector, business size, business age, ownership, market characteristics, access to insurance and expertise, and disaster experience (Biggs et al., 2012; Chang and Falit-Baiamonte, 2002; Graveline and Gremont, 2017; Howe, 2011; Marshall et al., 2015; Neise et al., 2021; Ngin et al., 2020; Webb et al., 2000; Wedawatta and Ingirige, 2016; Yoshida and Deyle, 2005). In these studies, the concept of place is often reduced to physical location and space. In a review of literature, 'place' is listed as the first determinant of business vulnerability (Tierney, 2007). According to Tierney (2007p. 276–7), "vulnerability of place" concerns the hazardousness of the locations in which business and economic activity take place, which is determined by structural fragility and spatial proximity to hazards. For example, many small tourism businesses operate in hazard-prone locations, such as coastal areas. Other empirical studies have shown a slightly broader scope than Tierney's (2007) account. Locational factors are operationalized as hazardous locations of business premises (Yoshida and Deyle, 2005; Marshall et al., 2015) and business activities (e.g. construction sites) (Wedawatta and Ingirige, 2016), the diversity of operating locations (Ngin et al., 2020; Howe, 2011), residence of owners (Graveline and Gremont, 2017), distance to market (Crick et al., 2018b), home-based operation (Torres et al., 2019), and land dependency (Stafford and Renaud, 2019), etc.

The emphasis on physical and spatial attributes cannot capture the richness of what being in a location means to organizational actors. Place is crucial for contextualizing organizational learning and change (Nissley, 2011) and sensemaking (Tisch and Galbreath, 2018, 2022). Place-based businesses can shape a place in ways that are conducive to enhancing sustainability and reducing vulnerability. Reductionist perspectives such as 'vulnerability of place' fail to explicitly recognize the processes of contextualization and sensemaking in which meanings are created and reproduced. This limitation is inherited from the broader field of organizational sustainability studies, which is criticized by Shrivastava and Kennelly (2013) as 'placeless'.

2.2. The concept of place in business and management research

Place is more than physical location and space. In human geography, place is an established multidimensional concept. It is seen as a product of the interaction of social actors and physical settings that influence and are influenced by material needs, cultures, social norms and relationships, perceptions, and emotions (Low and Altman, 1992). The concept encompasses location, physical environment, and socially constructed meaning derived from people's lived experience in the everyday world.

Human geographers recognize the social dimension of place, but their specific approaches emphasize different aspects of social life. Yi-Fu Tuan, for example, has described place as carrying cultural meanings and serving as the cornerstone of human emotional attachment (Tuan, 1974, 1977). To Edward Relph (1976), sense of place involves the quality of 'insideness', which is a state in which a person identifies with and belongs to a place. Place therefore has affective and cognitive aspects, shaping a person's emotion and identify.

Place functions not merely as a geographical point of reference, but also as a container and an enveloping environment (Agnew and Duncan, 1989). Cresswell (1996, 2015) argues that place implies a sense of proper; it refers to the ways in which individuals are placed in relation to social hierarchy and opportunity, who gains access to particular sites,

and what they can do. Nonetheless, place can be socially reconstructed by vulnerable populations and oppressed groups as a means of negotiating with those with the power to define their proper place (An et al., 2023). Place therefore implies behavioural expectations, which are contested in some cases. As Cresswell (2015) has noted, place is central to struggle and resistance.

This indicates that there are alternative approaches to understanding place. As Agnew and Duncan (1989) have suggested, these approaches have emphasized three different elements, i.e. location, locale, and sense of place. These elements are closely related to each other, but there are nuanced differences in the ways in which they are articulated and operationalized in research. For example, location can be studied in terms of the spatial distribution of economic activities and linked to market price differentials. Locale involves the settings for everyday routine social interaction and can be investigated by unpacking the social structures, institutions, and norms that shape or characterize a place. Sense of place, on the other hand, focuses on a person's identification, emotion, and cognition concerning a particular location or space. This dimension is often deemed as more subjective and personal, and less relevant to organizational practice than location and locale. As a result, sense of place theories are rarely mobilized and poorly developed in business and management studies.

Conventionally, the organizational account of place is articulated in terms of materiality (Shrivastava and Kennelly, 2013). The framing of 'place as landscape' is commonly used to understand organizational embeddedness into biophysical structures – the land and the environment, and its implications for access to resources and infrastructure development, especially for the primary industry. Place is also understood as primarily a geographical location that determines production cost and operational capacity (Guthey et al., 2014). Analyses have focused on economic considerations for the location of organizational activities, including transportation cost savings, access to labour, market expansion, and geographical economies of scale (Linnenluecke and Griffiths, 2015). This adds to the extensive literature on place branding, especially for the tourism and hospitality sectors (Campelo et al., 2013; François Lecompte et al., 2017). Place, therefore, is treated as a spatial variable to account for the economic value of organizational location.

The social construction of place is less evident in business and management research (Shrivastava and Kennelly, 2013). People experience and make sense of a place through their everyday encounters with the locale, social and cultural connections, and their collective memories and emotions towards the place (Kyle and Chick, 2007; Soini et al., 2012). Business organizations can act as place builders by improving the well-being of people and community, and fostering the shared meaning of a place. Place-building organizations operate in a manner that respects a community's values and culture, and recognizes the interdependent relationships between community and business (Thomas and Cross, 2007; Thomas et al., 2008). Shrivastava and Kennelly (2013) have proposed a theory of 'place-based enterprise', which refers to organizations that are rooted in a specific local community and have a distinctive sense of place. Place-based enterprises are characterized by attributes such as local ownership and control, anchoring of firm assets in place, and a social mission. They are more likely to pursue locally beneficial economic, social, and environmental outcomes compared to conventional enterprises.

The place-based account of sustainable organizations highlights the compatibility between organizational embeddedness in place and sustainable community development (Shrivastava and Kennelly, 2013; Guthey et al., 2014). Empirical evidence shows that the construction of community sense of place by business organizations is conductive for business and community success (Thomas et al., 2008). Deeply contextualized organizational practice can produce sustainable outcomes by strengthening location capability and building stronger linkages between business models and the local milieu (Zaheer and Nachum, 2011; Di Gregorio, 2017). Place-building, therefore, is viewed as a strategy for value creation.

The concept of sustainability, however, is different from vulnerability. Sustainability aims to balance environmental, social, and economic concerns for long-term well-being, emphasizing human-environment harmony, whereas vulnerability is usually portrayed in negative terms. According to Adger (2006, p. 268), vulnerability is "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt". Thomas and Cross (2007), Shrivastava and Kennelly (2013) and Guthey et al. (2014) have explained the materiality of place-based sustainable organizations, but have not elaborated on the dynamic relationships between place, risk, and vulnerability.

Sense of place is a contested element of place in the context of adverse change. Guthey et al. (2014) argue that modern people are distanced from the environmental consequences of their actions, and suggest that developing a deep sense of place is important for strengthening their sensual engagement with the material world. A deep sense of place, however, has mixed implications for resilience to extreme weather.

2.3. Sense of place and disaster risk management

Sense of place refers to the way in which people perceive and connect to specific locations or landscapes. It is a multidimensional concept encompassing the experience, bonding, meaning, commitment, perception, and emotion that an individual or group associates with a particular place (Bonaiuto et al., 2016; Quinn et al., 2019). The concept can be examined through various components, including place identity, place attachment, and place dependence (Jorgensen and Stedman, 2006; Soini et al., 2012). Although it is well known that sense of place influences people's response to natural hazards and climate change (Petzold, 2017; Xu et al., 2018), the concept is rarely tested in business settings.

Sense of place plays an important and positive role in business settings generally. There is a growing body of evidence about consumer behaviour (Brocato et al., 2015; van den Berg et al., 2021), branding (Campelo et al., 2013; Jarratt et al., 2018), organizational strategy (Thomas et al., 2008; Zaheer and Nachum, 2011), business development (Liu and Cheung, 2016), and job satisfaction (Miller et al., 2001). However, only a handful of studies have explicitly discussed and examined the role of sense of place in organizational response to natural hazards and climate change.

For instance, Marshall et al. (2012) have shown that higher levels of place attachment and place identity undermine the willingness of Australian peanut farmers to accept a transformational but costly strategy for adapting to water stress. Psychologists have explained why people's place attachment may reduce their intention to deal with changes that pose a threat to the place (Bonaiuto et al., 2016; De Dominicis et al., 2015). According to Bonaiuto et al. (2016, p.35), "people who are attached to their locale are likely to underestimate its potential vulnerability to risk". This is described as 'optimistic bias', where people attenuate unwelcome information as a protective strategy for safeguarding their identity with the place and reduce negative emotions associated with environmental adversities.

Sense of place has also shown a positive relationship with risk mitigation and resilience, but direct evidence is limited. Most studies focus on concepts linked to place, such as social capital (Torres et al., 2019; Biggs et al., 2012), and local traditions and culture (Parsons et al., 2018). Tisch and Galbreath (2018, 2022) have examined organizational resilience to extreme weather events in New Zealand. Their research highlights the importance of collective sensemaking among dairy farmers and the role of social connections, trust, and support in making sense of drought events, which helped them understand and navigate the challenges posed by climate change. However, sensemaking processes can constrain long-term resilience, as these farmers tended to focus on immediate and observable events, such as extreme weather patterns, rather than long-term climate change (Tisch and Galbreath,

2018, 2022).

To summarize, business vulnerability research has not demonstrated a deep engagement with the concept of place beyond the use of physical and spatial attributes in analysis. Studies of organizational practice in place building and community development are leaning towards the concept of sustainability. Marshall et al. (2012) and Tisch and Galbreath (2018, 2022) have investigated business vulnerability and resilience. However, Marshall et al. (2012) have only tested for general intention to deal with transformational change. Tisch and Galbreath (2018, 2022) have examined environmental sensemaking, rather than place more broadly. Both of these case studies involve a small group of farmers in industrialized economies. Neither of them has explored how the vulnerable business attributes are related to place. Little is known about the importance of place for explaining business vulnerability and its conceptual relevance to less resource-dependent industries in developing countries.

3. The study

3.1. Overview

This research explores the relationship between business vulnerability and sense of place. Our main research question is whether business owners and operators with stronger sense of place are more likely to operate a vulnerable business. We tested whether or not place identity, place attachment, and place dependence are related to the vulnerable characteristics of business. Evidence was solicited from a survey of coastal micro-businesses in the retail and hospitality sectors, which are among the most vulnerable ones in the tertiary industry, due to their high physical exposure (e.g., proximity to water, ground-level location) and very limited capacity to cope with natural hazards. Our study areas are located in southern China.

3.2. Questionnaire

A structured questionnaire was used to gauge small-business vulnerability to extreme weather. Based on Zhang et al. (2009), the scale of business vulnerability consists of eight components, grouped into four dimensions: 'capital', 'labour', 'supply', and 'customer/market'. Each dimension was measured by two or three items:

Capital

- Capital mobility: Proportion of goods and inventories that cannot be removed immediately under extreme weather
- Occupancy tenure (capital ownership): Rental expenditure as a percentage of operating income
- Asset diversification: Ownership of property outside the local area[2]

Labour

- Ease of employee replacement: Access to substitute labour within 2–3 h
- Labour proximity: Number of staff living in the local area

Supply

- Lifeline infrastructure dependence: Anticipated operation duration without water and power
- Inter-business dependence: Anticipated operation duration without inter-business supplies

Customer / market

- Market diversification: Proportion of local customers.
- Alternative operating location: Operating other branches or businesses outside the local area.

This framework considers the crucial entities and procedures that impact business activities, emphasizing that disturbances to business operations are just as significant as physical harm in gauging business loss and recovery (Chang and Falit-Baiamonte, 2002). Detailed explanations can be found in Zhang et al. (2009). We adapted their framework by incorporating additional noteworthy indicators from the literature. For instance, we added 'staff proximity' to the framework, measured by the number of employees residing in the local vicinity. This is grounded in the notion that disruptions in local population movement and work capacity may lead to a temporary decrease in local labour inputs (Song et al., 2016). Additionally, we inquired about the presence of any branches or businesses operating beyond the local area, serving as an indicator of geographical dispersion (Song et al., 2016; Tierney, 2007).

Sense of place was measured as self-reported sensual engagement with the place. We focus on the person's identification and bonding with the place and the material or perceived dependence on it. The design of our survey questions was informed by a psychological intervention, in which the concept is divided into three components (Jorgensen and Stedman, 2006):

Place Identity: the dimensions of self that define an individual's personal identity in relation to the physical environment. It involves conscious and unconscious ideas, beliefs, preferences, feelings, values, goals, and behavioral tendencies and skills relevant to a specific place.

Place Attachment: a positive bond that develops between individuals or groups and their environment. It involves emotional content and reflects the affective relationship between people and the landscape. It encompasses an interplay of emotions, knowledge, beliefs, behaviors, and actions in reference to a place.

Place Dependence: the perceived strength of association between an individual and specific places. It concerns how well a setting serves goal achievement given existing alternatives and involves comparing the current outcomes to those that would be obtained by selecting an alternative course of action.

These three components represent the cognitive, affective, and conative processes related to their physical environment, respectively. Each of them was measured by four questions on a five-point Likert scale, resulting in 12 survey questions. The exact wording is presented in Appendix.

Various factors were incorporated as controls to mitigate the influence of confounding variables. We considered the nature of the business, recognizing that businesses with higher capital intensity, like restaurants, tend to possess more or bigger mechanical or electrical equipment on their premises. Consequently, such establishments are at a higher risk of experiencing functional breakdowns and sustaining more substantial physical damage in the event of flooding compared to businesses with different characteristics. Business age was included as an indicator of the age of business facilities. To account for hazard experience, one additional item was constructed to gauge the level of damaged created by the last extreme weather event (i.e. typhoon and/or severe flooding). Two other items were used to record the respondent's key socioeconomic information, namely, age and sex.

3.3. Survey locations

The questionnaire was administrated to micro-businesses in China. According to the National Bureau of Statistics (2020), micro-businesses contribute to a relatively large proportion of employment in the Chinese retail sector, i.e. 43.9 %. This is higher than the 22.6 % of all sectors in the country. Hospitality micro-businesses account for 19.9 % of employment, falling behind the nationwide average by a small margin. Guangdong and Hainan are two of the Chinese provinces that registered more micro-business employment (24.2 % and 27.6 %) than the country

[2] 'Local area' was specified in the questionnaire as Macau, Sanya, or Wailingting/Dong'ao/Guishan Islands (for Zhuhai).

as a whole (22.6 %). In both provinces, over 88 % of all business entities are micro-businesses.

The study was conducted Sanya, Zhuhai, and Macau (Fig. 1). Sanya and Zhuhai are situated within the administrative jurisdictions of Hainan and Guangdong Provinces, respectively. Sanya is positioned at the southernmost point of China, off the southern peninsula of Guangdong. The city used to be administered by Guangdong Province, but became part of the newly designated Hainan Province in 1988. Zhuhai encompasses numerous small islands along its southeastern shore, situated at the estuaries of the flood-prone Pearl River Delta. Adjacent to Zhuhai, Macau is a Special Administrative Region of China.

The southern shores of China are located in a region susceptible to hazards near the Luzon Strait. Cities in this area face diverse coastal risks due to their expansive coastlines, close proximity to seasonal cyclone pathways, and adjacency to significant river systems. Specifically, the coastal regions of Guangdong Province are especially at risk from elevated sea levels, experiencing frequent impacts from tropical cyclones that bring formidable winds, substantial rainfall, and storm surges (Yin et al., 2012).

The research targeted specific areas of the city that is exposed to flooding or storms. Data primarily originated from retail trade and hospitality establishments situated in tourist hotspots. However, the chosen survey locations were deliberately diverse, considering variations in geographical features, peripheral location, the intensity of recent extreme weather incidents, formality of business, and the scale of the local economy.

Fieldwork in Sanya and Macau focused on their main urban areas. Sanya, a key tourism hub with significant economic potential, is known for its scenic locations and purpose-built tourism facilities along its extensive coastlines. Macau, renowned for its casinos and cultural heritage, was a Portuguese colony until 1999, when its sovereignty was returned to China. The survey sites in Sanya and Macau are very close to popular tourist attractions, attracting high customer traffic throughout the year, and feature a higher concentration of formal businesses. We specifically focused on coastal businesses in various locations around Sanya Bay. Despite the ongoing threat of seasonal typhoons to Hainan Island (Zhang et al., 2011), recent typhoon landfalls around Sanya Bay resulted in milder damage compared to the other two study areas. Sanya has received sufficient protection and pre-disaster support from the local government, due to its strategic economic significance. Additionally, residents in the area have not encountered a life-threatening cyclonic event in the past decade.

In contrast, Macau battled with the worst natural disaster the city had encountered in 50 years. In August 2017, Typhoon Hato, catagorized as Signal 10 (the highest intensity in the local typhoon warning systems), devastated Macau's densely populated districts by bringing up storm surges and a 2.25 m flood (Takagi et al., 2018; Takagi et al., 2021). The city of 0.67 million people was poorly prepared for the disaster, resulting in the tragic loss of 10 lives. Macau's economy also took a hit, experiencing a setback of $11.47 billion patacas (approximately US$1.42 billion). Local SMEs bore a significant brunt, facing a collective loss of $3.63 billion patacas (approximately US$44.9 million), as reported by the Government Information Bureau in 2017. The majority of these affected SMEs are concentrated in the Macau Peninsula, especially in the Inner Harbor area, which was chosen for investigation due to its high exposure and sensitivity to urban flooding.

Three rural islands of Zhuhai were selected as survey locations. Wailingting, Dong'ao, and Guishan Islands are isolated communities on the outskirts of Zhuhai, reachable only by ferries and boats. Initially thriving on fisheries and underground industries (Wang and Bennett, 2020), these islands in Zhuhai have faced economic challenges. Efforts to revitalize their economies through leisure tourism are hindered by their remote location and tough competition from more developed tourist destinations in the region. While these small islands are susceptible to high-intensity typhoons (Yin et al., 2012), their limited population, modest economic output, and elevations have mitigated losses from recent typhoon events (Lo et al., 2021, 2022). Nevertheless, their location, peripheral nature, and the informality of local businesses expose them to higher risks compared to those in Sanya.

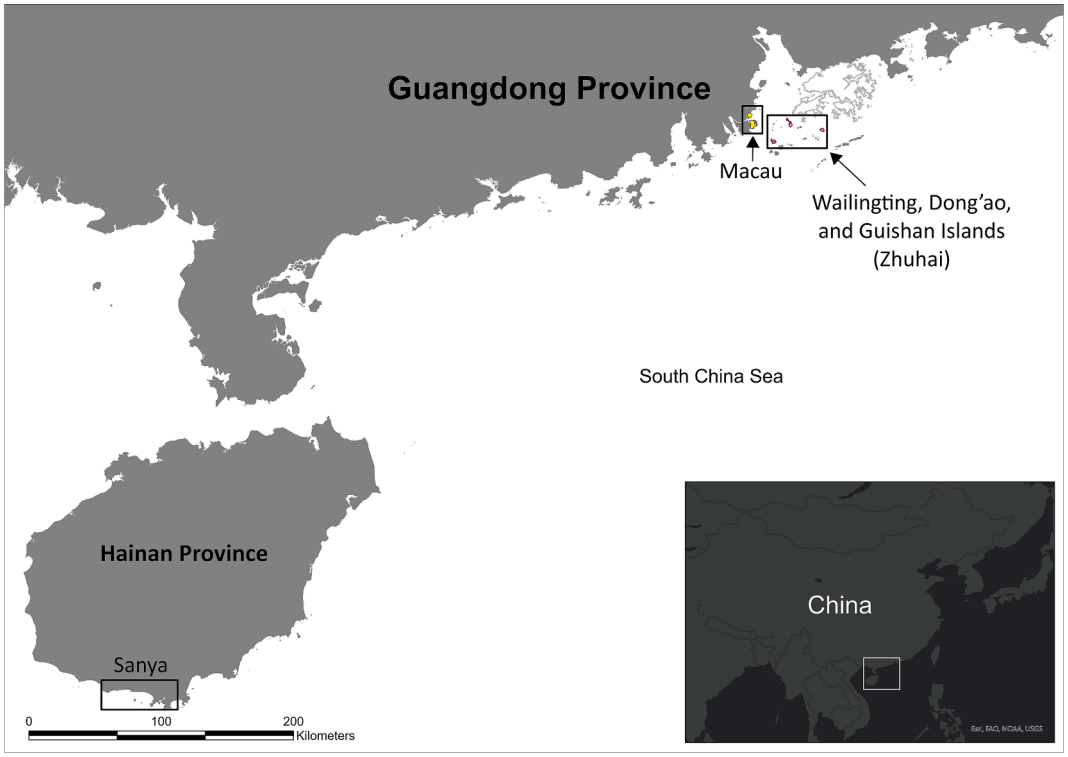

Fig. 1. Map of study areas.

3.4. Data collection

Structured interviews were conducted with micro-business owners and operators involved in everyday decision-making and coping with extreme weather. The International Finance Corporation (2013) defines micro-businesses as those with less than 5 employees. This is a strong definition, because it excludes the larger ones (> 5 employees) that could be understood as 'small' businesses. Our analysis was restricted to businesses that employed no more than 5 employees. All of them are considered as micro-businesses under the official classification system of China's National Bureau of Statistics (2018).

Our sampling approach was intentional, focusing on specific locations. We adopted Chang and Falit-Baiamonte's (2002) comprehensive strategy to engage with business operators, aiming to involve as many local businesses as possible. The survey locations had varying business establishments, ranging from approximately 50 to 200. Given the manageable population size, our data collection strategy began with direct, face-to-face contacts with nearly all ground-floor businesses in each location. In the smaller island communities of Zhuhai, our research assistants approached all present on a working day, inviting them to participate in interviews.

While the fieldwork in Macau and Sanya followed the same approach, we selected neighbourhoods or main scenic areas that experienced the greatest impacts of storms or flooding. In Sanya, the research team contacted beachside establishments around Sanya Bay and Dadong Sea, including Tianya-haijiao, Haipocun, and Donghai Road. In Macau, we selected 12 streets and lanes in Santo António, São Lourenço, and Nossa Senhora de Fátima Freguesias Parishes in the Inner Harbour area. This strategy aimed to provide a comprehensive view of business characteristics and responses in small impact areas (Chang and Falit-Baiamonte, 2002).

The research team visited each location a few times throughout the survey period. The questionnaire employed was consistent across these locations, with slight variations in languages and names. Each establishment underwent a maximum of one interview, conducted in either Mandarin or Cantonese, lasting an average of 20–30 min.

3.5. Estimation strategy

A probit model was estimated for each component of business vulnerability in order to determine the impacts of explanatory variables on individual items. The dependent variable was a discrete value representing whether or not a micro-business possesses a vulnerable characteristic, such as absence of staff living in the local area. The model is specified as:

$$p(y_i) = \alpha_1 + \beta_l x_{li} + \beta_m x_{mi} \cdots + \beta_s x_{si} + \varepsilon_{i1}$$

where $p(y_i)$ represents the probability of the respondent i possesses a vulnerable characteristic y (0) or not (1). α is the intercept. β is a vector of regression coefficients. $x_{li} \ldots x_{si}$ denotes explanatory variables, which include attributes of sense of place, business characteristics, level of economic damage, and the respondent's age and sex $l \ldots s$. ε_i is the error term.

An additional model was constructed, using a composite scale of business vulnerability as a dependent variable. This variable is computed by subtracting one from the mean scores of the 8 vulnerability items, so that higher values denote higher levels of vulnerability. The Ordinary Least Squares (OLS) regression was used in the analysis. The OLS model is specified as:

$$1 - (\sum_{k=1}^{8} y_i)/k = \alpha_2 + \beta_l x_{li} + \beta_m x_{mi} \cdots + \beta_s x_{si} + \varepsilon_{i2}$$

where y_i indicates the mean score of the vulnerability items. All other variables are as defined in Equation 1.

4. Results

4.1. Descriptive statistics

Our analysis was based on 300 completed questionnaires from Macau, Zhuhai, and Sanya. The number of observations in the city subsamples is 112, 95, and 93, respectively. These sub-samples show variations in the type of business (Fig. 2). The survey locations in Macau are characterized by their mixed land-use, high densities, and proximity to the Central Business District (CBD). As a result, the Macau sub-sample consists of a variety of micro-businesses serving multiple ends. The majority of them are boutiques, grocery stores, pharmacies, snack shops, and dry food retailers. The Zhuhai islands are predominantly tourist destinations and far away from the Zhuhai CBD. This results in a rather homogenous sub-sample, which mainly includes tourism-oriented accommodation providers, grocery stores and snack shops. Sanya is also a tourist destination, but the survey was conducted near the CBD. Consequently, there is a relatively large number of snack shops and restaurants targeting tourists, as well as those targeting local residents, such as boutiques.

The vulnerable characteristics of business are presented in Table 1. In Macau and Sanya, more than half of the micro-businesses surveyed reported that more than 50 % of their goods and inventories cannot be removed immediately under extreme weather (A1). While only 45.3 % of those in Zhuhai islands reported the same, the differences are not statistically significant. Similar differences are found in the proportion of rental expenditure in operating income, an indicator of capital ownership (A2). Over 10 % of the Macau and Sanya micro-businesses reported that rental expenditure accounts for more than half of their operating income, but this is not statistically different from those reported by Zhuhai micro-businesses.

Statistical significance is found in most other dimensions of vulnerability. Much fewer of those business owners and operators in Macau than Zhuhai and Sanya indicated difficulties in finding a replacement for an employee or themselves who cannot go to work due to emergency (A3). More micro-businesses in Sanya reported having no employees living in the local area (A4). This suggests that their labour vulnerability is particularly higher than those in Macau and Zhuhai.

Micro-businesses in Zhuhai islands are distinguishable in terms of supply vulnerability. They are more likely to operate for longer than 12 h in the event of lifeline service and supply disruption (A5 and A6). Their lower dependence on external resources can be seen as a natural adaptation to the physical isolation of Zhuhai islands from the city centres and the frequent occurrence of typhoon during summer, for which reserves and emergency arrangements are deemed necessary.

Customer base contributes to the vulnerability of Macau micro-businesses (A7). Most of them served more local customers from the city than tourists. During the aftermath of a disaster, businesses can lose customers due to short-term population dislocation or contraction in discretionary spending by local residents who are themselves disaster victims. This can be especially fatal for small businesses, as regaining customers can take a long period of time. Disasters can also cause consumer preferences to change, leading to a decrease in market demand for certain products and services (Tierney, 2007; Zhang et al., 2009). Sanya shows a sharp contrast to Macau, due to its focus on the national and international markets.[3] There is no significant difference between the three cities in alternative operating location as a diversification strategy (A8), but more of those in Zhuhai islands have off-site business investments.

Table 2 displays the values of the 12 items representing sense of place across the three cities. The sense of place scale clearly distinguishes Zhuhai islands from Macau and Sanya, probably due to the rurality of

[3] Macau is also an international tourism city, but the neighbourhoods in which our survey was conducted do not attract the bulk of tourists.

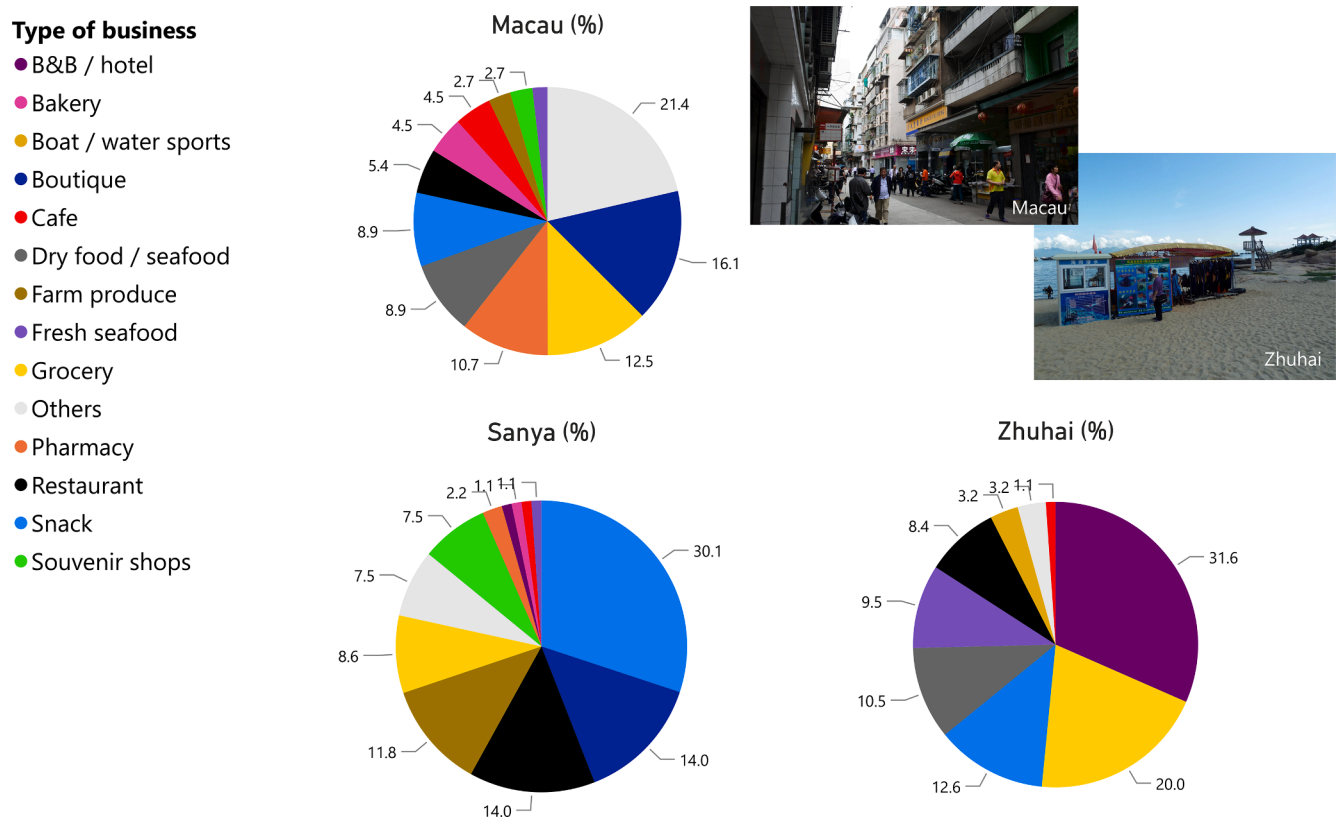

Fig. 2. Distribution of micro-businesses in the sample Caption: numbers represent the percentages of respondents by business type. N = 112 (Macau), 95 (Zhuhai), Sanya (93). The business survey were conducted in Santo António, São Lourenço, and Nossa Senhora de Fátima Freguesias Parishes in the Inner Harbour area (Macau); Wailingting, Dong'ao, and Guishan Islands (Zhuhai); and Sanya Bay and Dadong Sea, including Tianya-haijiao, Haipocun, and Donghai Road (Sanya).

these islands and the lifestyle motives behind business development (Liu, 2014). On average, Zhuhai micro-businesses indicated higher levels of place identity (S1 – S4) and, to a lesser extent, place attachment (S5 – S8). The differences in place dependence (S9 – S12) are marginal. Those in Macau showed the lowest overall score. A possible reason is that many of those who work in the city are recent migrants from Mainland China, who have not developed bonding with the place in which they make a living. This can also explain the lower scores of Sanya, which has attracted many internal migrants to work in its thriving tourism industry and therefore has a higher degree of employment mobility than the Zhuhai islands.

The average values of business vulnerability and sense of place for the full sample are presented in Table 3. The normalized composite vulnerability score indicates the overall level of business vulnerability to extreme weather: the higher the values, the higher the levels of vulnerability. Two of the place dependence items (S11 and S12) are excluded, because they do not form a statistically reliable scale (Cronbach's alpha < 0.70).

Table 3 also shows the average values of five variables representing business and respondent characteristics. Only 25 % of the surveyed micro-businesses are regarded as capital-intensive, and only 19 % of them have operated for 20 years or longer. Many of them, predominantly those in Macau, recorded significant damage from the last extreme weather event. A little more than 50 % of the micro-businesses are operated by younger people (<40) and females. especially in Macau.

4.2. Regression analysis

The probit regression models for the full sample are shown in Table 4. The table presents the values of regression coefficients (β) and marginal effects. Marginal effects are interpreted in terms of a percentage change in the likelihood of reporting the dependent variable outcome for a one-unit or discrete change in the independent variable. Location dummies are included to control for unobserved heterogeneity between sub-samples.

Each of the vulnerability indicators is used as a dependent variable and examined in terms of their relationship with the sense of place scale. Three of them are omitted, i.e. A2, A4 and A8, as they do not correlate with any of the place variables in the full sample or the Macau sub-sample. The three composite place variables have produced satisfactory reliable scores, indicating internal consistency. The values of their Cronbach's alpha are 0.86 (place identity), 0.88 (place attachment), and 0.73 (place dependence).

The place variables are not associated with the vulnerability indicators, except market diversification (A7). The positive relationship between place identity and the proportion of local customers suggests that those who have developed a stronger identity with the place are more likely run a business that serves more customers from outside the local area. This implies that the demand for their service/product is less susceptible to local extreme weather events.

Stronger results are found in the Macau sub-sample (Table 5). The five vulnerability indicators are associated with at least one place variable. Positive relationships are recorded for capital mobility (A1), inter-business dependence (A6), and market diversification (A7). Macau business owners and operators with a higher level of place identity are more likely to move out their goods and inventories, to continue operation for over 12 h without business supplies, and to serve non-local customers. However, they are less likely to find replacement employees in the event of extreme weather (A2).

Ease of employment replacement is similarly related to place dependence. Those who believe that the local area is the best place to do what they are interested are less likely to find replacement employees. However, the values of this variable (A2) increase with place attachment, suggest that replacing employees when needs arise is less

Table 1
Distribution of response for nine components of business vulnerability to extreme weather.

Dimension	Description	Percentage of business (%)			X^2
		Macau (N = 112)	Zhuhai (N = 95)	Sanya (N = 93)	
A1. Capital mobility	*Proportion of goods and inventories that cannot be removed immediately under extreme weather*				n.s
	More than 50 %	57.1	45.3	59.1	
	Otherwise	42.9	54.7	40.9	
	Total	100	100	100	
A2. Occupancy tenure (capital ownership)	*Rental expenditure as a percentage of operating income*				n.s
	More than 50 %	10.7	4.2	14.0	
	Otherwise	89.3	95.8	86.0	
	Total	100	100	100	
A3. Ease of employee replacement	*Access to substitute labour within 2–3 h*				***
	Not possible / very difficult	27.7	50.5	63.4	
	Otherwise	72.3	49.5	36.6	
	Total	100	100	100	
A4. Labour proximity	*Number of staff living in the local area*				***
	None	21.4	14.7	61.3	
	At least one	78.6	85.3	38.7	
	Total	100	100	100	
A5. Lifeline infrastructure dependence	*Anticipated operation duration without water and power*				***
	Less than 12 h	92.0	65.3	81.7	
	Otherwise	8.0	34.7	18.3	
	Total	100	100	100	
A6. Inter-business dependence	*Anticipated operation duration without inter-business supplies*				***
	Less than 12 h	75.0	29.5	63.4	
	Otherwise	25.0	70.5	36.6	
	Total	100	100	100	
A7. Market diversification	*Proportion of local customers*				***
	More than 50 %	75.9	13.7	4.3	
	Otherwise	24.1	86.3	95.7	
	Total	100	100	100	
A8. Alternative operating location	*Operating other branches or businesses outside the local area*				n.s
	No	91.1	84.2	93.5	
	Yes	8.9	15.8	6.5	
	Total	100	100	100	

challenging for those emotionally attached to the local area. Lifeline infrastructure dependence (A5) is associated with place attachment only. The negative relationship suggests that locally attached business owners and operators in Macau are less likely to continue operation for over 12 h without water and power. These results indicate an ambivalent relationship between business vulnerability and sense of place. The Zhuhai and Sanya sub-samples are omitted, as no significant results are found.

The composite vulnerability score is used in a separate analysis in an attempt to show more conclusive evidence. Results of an OLS model are presented in Table 6. Although most of the independent variables lack statistical significance, place identity remains a strong predictor of business vulnerability for the Macau sub-sample. In this model, the dependent variable is coded differently so that the negative sign of the coefficient means the stronger the place identity, the lower the vulnerability. In the full sample, only the variable of female operator has demonstrated strong explanatory power.

Table 2
Descriptive statistics for sense of place.

Dimension	Macau (N = 112)		Zhuhai (N = 95)		Sanya (N = 93)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
S1. Place identity – reflect personality	2.83	0.70	3.63	0.80	3.01	0.90
S2. Place identity – be myself	3.10	0.79	3.63	0.91	3.09	0.96
S3. Place identity – help understand myself	3.28	0.71	3.73	0.79	3.14	0.97
S4. Place identity – reflect myself	2.75	0.94	3.85	0.86	2.85	1.12
S5. Place attachment – feel relaxed	3.21	0.95	4.22	0.67	3.69	0.97
S6. Place attachment – feel happy	3.53	0.87	4.14	0.78	3.72	0.98
S7. Place attachment – favorite place	3.53	1.00	3.86	0.86	3.68	1.00
S8. Place attachment – missing it when away	3.31	0.89	3.73	0.99	3.41	1.09
S9. Place dependence – best for doing things I enjoy	3.21	0.91	3.65	0.97	3.47	0.92
S10. Place dependence – no alternative	2.88	0.85	3.38	0.93	3.04	0.93
S11. Place dependence – not a good place	2.88	0.82	2.87	0.84	2.65	0.95
S12. Place dependence – there are alternatives	3.29	1.08	3.18	0.99	3.08	1.12
Average	3.12	0.50	3.64	0.59	3.28	0.66

4.3. Robustness checks

Three statistical tests are performed to examine the robustness of the OLS model, which includes a more representative dependent variable (i.e. overall business vulnerability. The scrutiny focuses on heteroskedasticity, multicollinearity and endogeneity. The Breusch-Pagan / Cook-Weisberg test is used to test for heteroskedasticity. The results are not significant for both the Macau sub-sample ($\chi^2 = 1.73$, $p > 0.05$) and the full sample ($\chi^2 = 0.37$, $p > 0.05$), clearing concerns about heteroskedasticity in the dependent variable. Furthermore, the values of variance inflation factor (VIF) and Tolerance for both samples are less than 5 and greater than 0.20, respectively. Therefore, no issue about multicollinearity is identified. Finally, the Durbin–Wu–Hausman test is performed to investigate the endogeneity of place identity. The test returns a p value greater than 0.05, failing to reject the null hypothesis that the variable of place identity is exogenous.

There is a methodological limitation about the use of the composite variable. The business vulnerability scale does not yield a satisfactory Cronback's alpha value (< 0.70). Therefore, the results should be carefully interpreted along with those presented in Table 5, which shows the effects of individual vulnerability indicators, rather than their aggregate values. The caveat is that these indicators correlate with the place variables in different directions.

5. Discussion

This research explores the relationship between micro-business vulnerability to extreme weather and sense of place. The findings show that they are linked to each other, but the linkages do not seem to be coherent. Nonetheless, this research is exploratory, and the mixed evidence has raised important questions and presented new ideas for further investigation. Four key insights are discussed below.

Firstly, the observations about micro-business vulnerability are departed from usual assumptions. Low turnover, smaller business size, and poor financial capacity are regarded as key sources of vulnerability (Marshall et al., 2015; Graveline and Gremont, 2017; Crick et al., 2018b; Ngin et al., 2020). Micro-businesses in the Zhuhai islands are smaller, physical isolated, and confined to a smaller and less lucrative tourism market. However, their lower vulnerability scores suggest that they

Table 3
Descriptive statistics (N = 300).

Dependent variable		Range	Mean	S.D.
A1. Capital mobility	Proportion of goods and inventories that are immobile. More than 50 % (0), otherwise (1)	0 – 1	0.46	0.50
A2. Occupancy tenure	Rental expenditure as a percentage of operating income. More than 50 % (0), otherwise (1)	0 – 1	0.90	0.30
A3. Ease of employee replacement	Access to substitute labour. Not possible / very difficult (0), otherwise (1)	0 – 1	0.54	0.50
A4. Labour proximity	*Number of staff living in the local area.* None (0), at least one (1)	0 – 1	0.68	0.47
A5. Lifeline infrastructure dependence	Anticipated operation duration without water and power. Less than 12 h (0), 12 h or longer (1)	0 – 1	0.20	0.40
A6. Inter-business dependence	Anticipated operation duration without inter-business supplies. Less than 12 h (0), 12 h or longer (1)	0 – 1	0.43	0.50
A7. Market diversification	Proportion of local customers. More than 50 % (0), otherwise (1)	0 – 1	0.66	0.48
A8. Alternative operating location	Operating other branches or businesses outside the local area. No (0), yes (1)	0 – 1	0.10	0.31
Vulnerability	One minus mean of eight items (A1 – A8)*	0 – 1	0.50	0.17
Independent variable				
Place identity	Mean of four items (S1 – S4)^	1 – 5	3.23	0.79
Place attachment	Mean of four items (S5 – S8)^	1 – 5	3.65	0.82
Place dependence	Mean of two items (S9 and S10)^	1 – 5	3.26	0.83
Business type	The type of business being capital intensive. Yes (1), no (0)	0–1	0.25	0.44
Business age	Number of years the business has operated in the local area. 20 years or longer (1), less than 20 years (0)	0–1	0.19	0.40
Extreme weather damage	Significance of economic losses from the last flooding or typhoon event. No (1), Little (2), Some (3), Significant (4), Very significant (5)	1–5	3.15	1.07
Younger operator	The operator is aged 40 or younger (1), over 40 (0)	0–1	0.56	0.50
Female operator	Female operator (1), male operator (0)	0–1	0.53	0.50

* Subtraction was applied so that higher values denote higher degree of vulnerability.
^Higher values denote stronger place identity / attachment / dependence.

possess more resilient characteristics, such as a greater capacity to manage operational interruptions.

This raises questions about reducing micro-business vulnerability to a matter of resource availability. Organizational resilience to extreme weather can be enhanced by developing various capabilities, which include disaster sensemaking and distribution of resources (e.g., workforce decentralization and physical dispersion of assets) (Linnenluecke et al., 2012). Such capabilities can be developed through organizational learning under adversity. Some of the small rural businesses are naturally resilient, because they have to live with rurality, peripherality, and physical exposure of the islands to typhoons. The ways in which small rural businesses adapt their operational practice to the place under resource constraints are important for understanding their resilience to extreme weather.

Secondly, the strong explanatory power of sense of place is limited to the Macau sub-sample. Combined or separately analysed, the data collected from Zhuhai and Sanya have offered limited empirical support. A closer investigation suggests that micro-businesses in the Zhuhai islands have a much stronger sense of place and lower vulnerability than those in Macau. However, micro-businesses in Macau do not show substantial differences from those in Sanya in these terms. Another main difference is that the Macau experienced a catastrophic urban flooding event in 2017, several months before our survey was conducted, whereas the impact on the other two study areas was modest.

Typhoon Hato exposed the problem of trust in the Macau Government. The Macau Government failed to issue early earnings to the public and lacked institutional capacities for managing a meteorological crisis, causing delays in evacuation and emergency response, shortage of lifeline supplies and food, and poor inter-departmental coordination (Chan et al., 2018; Takagi et al., 2021). The poor performance triggered enormous public outrage and forced local people and businesses to solicit support from the community and neighbourhood. Locally attached businesses typically have deeper engagement and stronger networks in the local area, which can help accelerate their evacuation and recovery from the disaster. This view is supported by Tisch and Galbreath (2018, 2022) who conclude that collective sensemaking within communities and social connections helped farmers navigate drought conditions. A possible theory is that the devastating extreme weather event in 2017 resulted in a renegotiation of place (Lo et al., 2024), which became a site for struggle and resistance (Cresswell, 2015). The relatively more resilient micro-businesses in Macau might have developed a stronger sense of place through the collective agency among members of the community. A fruitful research direction would be examining how recent experiences in natural catastrophes shape the ways in which organizational actors engage in the place.

Moreover, sense of place and business vulnerability do not show coherence. For example, ease of employee replacement in Macau is negatively related to place identity and place dependence, but positively related to place attachment. To micro-businesses, the ease of replacing employees during or after an emergency event depends on their social and organizational networks. The positive results corroborate other studies that demonstrate the role of social capital in organizational recovery from environmental shocks (Biggs et al., 2012; Torres et al., 2019), but the negative results demand further explanations. A possible explanation is that place identity and place dependence are articulated in neutral or less positive terms (Jorgensen and Stedman, 2006). People's satisfaction with (attachment to) the place may be derived from their stronger networks within the community, but the concepts of place identity and place dependence merely describe a perceived relationship with the place and are not necessarily linked with networking capabilities. In addition, although place attachment is positively related to ease of employee replacement, it has a negative relationship with lifeline infrastructure dependence in the context of Macau. On the latter one, a similar observation has been reported by Marshall et al. (2012), who suggest that place attachment can undermine the intention to adapt organizational practice to water stress. Locally attached businesses are less likely to make preparation and adjustment to uncertainties in climatic conditions.

These conflicting results raise issues about multidimensionality of the concept of place in business settings. As discussed earlier in this paper, place has cognitive, affective, and conative aspects, is a carrier of behavioural expectations and norms, and is politically charged. These different dimensions allow multiple ways for understanding how place is related to vulnerability, which is also a complex multidimensional concept. The multidimensionality has not been fully recognized in Shrivastava and Kennelly (2013) and Guthey et al. (2014). These authors have made a strong case for introducing the concept of place, but outlined a largely linear and positive relationship between place and sustainability. The weakest link lies in how sensual engagement with a place and subjective experience are related to business practice.

Place is not a homogenous social construct. In this paper, we have focused on sensual engagement with a place and its three empirically distinctive expressions, i.e. place identity, attachment, and dependence. The multiple dimensions and manifestations of sensemaking can shape

Table 4
Probit regression (full sample).

	A1. Capital mobility		A2. Ease of employee replacement		A5. Lifeline infrastructure dependence		A6. Inter-business dependence		A7. Market diversification	
	β	Marginal effects	β	Marginal effects	β	Marginal effects	β	Marginal effects	β	Marginal effects
Place identity	0.223	0.085	−0.203	−0.071	−0.135	−0.034	0.138	0.046	**0.602*****	**0.121*****
	(0.135)	(0.051)	(0.139)	(0.048)	(0.167)	(0.041)	(0.142)	(0.047)	(0.178)	(0.035)
Place attachment	−0.071	−0.027	0.055	0.019	−0.131	−0.033	−0.017	−0.006	−0.197	−0.040
	(0.140)	(0.053)	(0.146)	(0.051)	(0.169)	(0.042)	(0.147)	(0.049)	(0.180)	(0.036)
Place dependence	−0.182	−0.069	−0.226	−0.079	0.182	0.045	0.064	0.021	0.017	0.003
	(0.139)	(0.053)	(0.146)	(0.050)	(0.170)	(0.042)	(0.149)	(0.050)	(0.182)	(0.036)
Business type	−0.013	−0.005	0.050	0.017	0.066	0.016	−0.208	−0.070	−0.261	−0.052
	(0.178)	(0.068)	(0.180)	(0.063)	(0.201)	(0.050)	(0.185)	(0.062)	(0.246)	(0.049)
Business age	0.081	0.031	0.183	0.064	0.015	0.004	−0.071	−0.024	−0.032	−0.007
	(0.207)	(0.079)	(0.211)	(0.073)	(0.247)	(0.061)	(0.219)	(0.073)	(0.254)	(0.051)
Extreme weather damage	−0.106	−0.041	**0.378****	0.132	−0.182	−0.045	0.332	0.111	−0.023	−0.005
	(0.181)	(0.069)	(0.186)	(0.064)	(0.227)	(0.056)	(0.194)	(0.064)	(0.240)	(0.048)
Younger operator	0.304	0.116	0.137	0.048	−0.265	−0.066	0.103	0.035	0.286	0.057
	(0.165)	(0.062)	(0.168)	(0.058)	(0.196)	(0.048)	(0.173)	(0.058)	(0.214)	(0.043)
Female operator	0.231	0.088	0.173	0.060	0.208	0.052	0.252	0.084	−0.003	−0.001
	(0.150)	(0.057)	(0.155)	(0.054)	(0.179)	(0.044)	(0.157)	(0.052)	(0.197)	(0.039)
Constant	−0.236		**1.160****		0.409		0.509		**−1.777*****	
	(0.467)		(0.481)		(0.549)		(0.504)		(0.622)	
Location dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.035		0.111		0.098		0.138		0.439	
Likelihood Ratio χ^2 (10)	14.64		45.88		29.26		56.61		168.65	
Prob > χ^2	0.146		0.000		0.001		0.000		0.000	
Goodness-of-fit Pearson χ^2 (277)	296.28		287.73		265.80		297.64		331.80	
Prob > χ^2	0.203		0.316		0.675		0.188		0.013	
Number of observations	300		300		300		300		300	

Standard errors are in parentheses.
*** and ** denote significance at 0.01 and 0.05 levels respectively.

organizational practice in different ways, consequently leading to the mixed effects on business vulnerability and resilience as observed from Macau. This multidimensionality is not explicitly incorporated into place-based frameworks, such as Shrivastava and Kennelly's (2013) 'place-based entreprise'.

Shrivastava and Kennelly (2013) define 'place-based entreprise' in terms of rootedness and interdependence with place. They have addressed the broader organizational context, but not adequately accounted for the micro-processes of sensemaking, such as place identification and personal attachment, that influence the practice of the smallest organizations (i.e. micro-businesses) and their very small team of management. Similar limitations are also noticeable from other studies that focus on larger organizations, such as Thomas et al. (2008) and Di Gregorio (2017), in which decision-making is more dispersed and strategically oriented. A place-based theory would need to recognize the wide-ranging manifestations of place and sense of place for organizations of different size and operating at different scales.

Lastly, the way in which vulnerability is conceptualized in relation to place is contested. Studies of business vulnerability to extreme weather have tended to reduce the concept of place to its physical dimensions, and overlook its social and cultural dimensions, including sensemaking. The materiality and spatiality of a place are represented by Tierney's (2007) 'vulnerability *of* place', which emphasizes the hazardousness of a location. Such a deterministic approach is demonstrated in various methodological decisions (Yoshida and Deyle, 2005; Zhang et al., 2009; Howe, 2011; Graveline and Gremont, 2017; Crick et al., 2018b; Torres et al., 2019; Stafford and Renaud, 2019), as discussed in Section 2.1.

The findings help understand the notion of 'vulnerability with place'. We argue for a more dynamic approach that recognizes the interrelationship between business vulnerability and place, and the making sense of place. Vulnerability is a broader concept than hazard exposure and sensitivity, encompassing human capacity to cope and adapt to change (Adger, 2006). Such a capacity can be influenced by the sense of place, environment, or disaster (Linnenluecke et al., 2012; Marshall et al., 2012; Tisch and Galbreath, 2018, 2022).

Nonetheless, our research provides initial clues about a possible reverse process, i.e. a vulnerable business may have reduced sense of place. Some of our vulnerability indicators are articulated not in the context of extreme weather (e.g., A2, A7) and unlikely to be driven by sense of place (e.g., A1). Our statistical analysis cannot determine if sense of place causes vulnerability. It is possible that observed or actually experienced vulnerabilities (e.g., inundation and losses) result in people's frustration and resistance to indicating affinity and bonding with the place in which they work or operate a business. In fact, it is not uncommon that people put an end to their business and relocate in the aftermath of a major natural catastrophe (Marshall et al., 2015; Torres et al., 2019). Vulnerability can change with a certain way of engaging the place, and *vice versa*. Place is fluid and contested (Cresswell, 2015; An et al., 2023); it shapes and is shaped by people's experience in the location and environment. This dynamic approach recognizes the idea that vulnerabilities and elements of place, including living, meaning, and feeling, can affect and reproduce each other.

6. Conclusions

Business and management research has focused on how larger organizations respond to extreme weather events (Linnenluecke et al., 2012; Crick et al., 2018a; Crick et al., 2018b). Although there are various attempts to understand the resilience of small businesses, most of them use evidence from developed countries and operationalize the concept of place as physical location and space. A theory of place-based business is framed in terms of sustainability, and less of vulnerability (Guthey et al., 2014; Shrivastava and Kennelly, 2013). Business and management research has struggled to incorporate the conceptual

Table 5
Probit regression (Macau only).

	A1. Capital mobility		A2. Ease of employee replacement		A5. Lifeline infrastructure dependence		A6. Inter-business dependence		A7. Market diversification	
	β	Marginal effects	β	Marginal effects	β	Marginal effects	β	Marginal effects	β	Marginal effects
Place identity	**0.609****	**0.205****	**−0.673****	**−0.179*****	0.016	0.052	**0.625****	**0.182****	**1.002*****	**0.259*****
	(0.255)	(0.080)	(0.277)	(0.068)	(0.423)	(0.040)	(0.275)	(0.075)	(0.303)	(0.068)
Place attachment	−0.383	−0.129	**0.585****	**0.155****	**−0.720****	**−0.088****	−0.147	−0.043	−0.201	−0.052
	(0.221)	(0.071)	(0.270)	(0.068)	(0.374)	(0.046)	(0.232)	(0.067)	(0.245)	(0.063)
Place dependence	−0.042	−0.014	**−0.728****	**−0.193*****	0.466	0.057	0.073	0.021	0.002	0.001
	(0.234)	(0.079)	(0.291)	(0.072)	(0.419)	(0.052)	(0.256)	(0.075)	(0.271)	(0.070)
Business type	0.668	0.226	0.110	0.029	−0.636	−0.078	−0.158	−0.046	0.501	0.130
	(0.425)	(0.138)	(0.433)	(0.115)	(0.608)	(0.074)	(0.413)	(0.120)	(0.492)	(0.126)
Business age	0.491	0.166	−0.089	−0.024	−0.244	−0.030	−0.276	−0.080	−0.456	−0.118
	(0.368)	(0.121)	(0.380)	(0.101)	(0.666)	(0.082)	(0.363)	(0.105)	(0.384)	(0.098)
Extreme weather	−0.413	−0.139	**1.207*****	**0.320*****	0.248	0.030	−0.082	−0.024	−0.534	−0.138
damage	(0.317)	(0.105)	(0.353)	(0.080)	(0.578)	(0.071)	(0.323)	(0.094)	(0.350)	(0.088)
Younger operator	0.615	0.208	−0.098	−0.026	−0.929	−0.114	0.115	0.034	−0.052	−0.013
	(0.339)	(0.109)	(0.353)	(0.094)	(0.658)	(0.081)	(0.343)	(0.100)	(0.359)	(0.093)
Female operator	0.210	0.071	−0.209	−0.055	0.378	0.047	0.261	0.076	0.113	0.029
	(0.269)	(0.090)	(0.297)	(0.078)	(0.416)	(0.051)	(0.285)	(0.083)	(0.302)	(0.078)
Constant	−1.553		**2.241****		−0.027		**−2.060****		**−2.860*****	
	(0.926)		(0.964)		(1.467)		(0.970)		(1.054)	
Location dummies	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pseudo R^2	0.130		0.204		0.173		0.081		0.161	
Likelihood Ratio χ^2 (8)	19.88		26.99		10.86		10.26		19.86	
Prob > χ^2	0.011		0.001		0.210		0.247		0.011	
Goodness-of-fit Pearson χ^2 (95)	110.53		99.77		61.51		107.89		105.52	
Prob > χ^2	0.132		0.349		0.997		0.173		0.218	
Number of observations	112		112		112		112		112	

Lower values of the dependent variable denote higher degree of vulnerability.
Standard errors are in parentheses.
*** and ** denote significance at 0.01 and 0.05 levels respectively

Table 6
OLS regression.

	Macau only			Full sample		
	Coefficients	95% Confidence Interval		Coefficients	95% Confidence Interval	
Place identity	**−0.083*****	−0.131	−0.035	−0.026	−0.056	0.004
	(0.024)			(0.015)		
Place attachment	0.016	−0.026	0.058	0.019	−0.012	0.050
	(0.021)			(0.016)		
Place dependence	0.038	−0.008	0.084	0.010	−0.021	0.042
	(0.023)			(0.016)		
Business type	−0.015	−0.092	0.061	0.018	−0.022	0.058
	(0.039)			(0.020)		
Business age	0.055	−0.016	0.127	0.006	−0.040	0.053
	(0.036)			(0.024)		
Extreme weather damage	0.013	−0.049	0.075	−0.004	−0.045	0.037
	(0.031)			(0.021)		
Younger operator	−0.002	−0.067	0.064	−0.021	−0.058	0.016
	(0.033)			(0.019)		
Female operator	−0.035	−0.088	0.018	**−0.049*****	−0.083	−0.015
	(0.027)			(0.017)		
Constant	**0.617*****	0.438	0.796	**0.557*****	0.452	0.662
	(0.090)			(0.053)		
Location dummies	NO			YES		
Adj. R^2	0.102			0.248		
F	2.57			10.87		
Prob > F	0.013			0.000		
Number of observations	112			300		

Dependent variable: Vulnerability. Higher values denote higher degree of vulnerability
*** and ** denote significance at 0.01 and 0.05 levels respectively.

multidimensionality of place and its dynamic relationship with vulnerability accumulation into investigation. Sense of place, in particular, is the least explored dimension.

Our research has explored these issues, using evidence from China. Statistical linkages between micro-business vulnerability to extreme weather and sense of place are detected, but they do not seem to be perfectly coherent. Although the results require further explanations and validation, they generate new insights for future research about the interaction between place and micro-business. Future attempts to clarify the role of place require a dynamic approach to recognize and explain the mechanisms as to how vulnerabilities and elements of place reinforce or undermine each other.

For example, we know how a location determines vulnerability, but not much about how sense of place and organizational place-building efforts shape vulnerable or resilient organizational practice and decisions, and how significant disaster damage and risks alter the ways in which organizational actors engage and identify with the place. Intriguing questions about such an interrelationship include how local businesses and the community co-produce the place while introducing resilient practice, and how the strengthening of place identity and attachment may create perverse outcomes, such as reproduction of vulnerability. Other issues that warrant an investigation include whether rural businesses possess more resilient characteristics, whether the multiple dimensions of sense of place contribute to different resilient outcomes, and whether they influence organizational practice for sustainability and vulnerability reduction in different ways.

CRediT authorship contribution statement

Alex Y. Lo: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lewis T.O. Cheung:** Writing – review & editing, Resources, Project administration, Methodology, Data curation, Conceptualization. **Shuwen Liu:** Project administration, Methodology, Data curation.

Declaration of competing interest

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

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

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