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## Supply chain resilience: a multi-level framework

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### ABSTRACT

Grounded in middle-range theory (MRT), this study explores supply chain resilience (SCRes) during the 2021 Henan floods through 54 interviews with agri-food industry practitioners. The findings reveal SCRes to be a multi-level framework determined by individuals, organizations, supply chains, and broader environments collectively. The environmental level, comprising political, economic, social, technological, environmental, legal, and cultural (PESTELC) factors, functions as the resource layer, providing critical resources. The supply chain level is the direction layer, setting goals for preparation, response, recovery, and adaptation by the organizations and individuals involved. The organizational level is the transmission layer, disseminating resilience objectives both horizontally and vertically. Finally, the individual level is the implementation layer, operationalizing organizational and SCRes strategies. Organizational employees' personal attributes, such as openness, persistence, and extraversion, should be carefully considered when implementing SCRes strategies. China's hierarchical culture, chain leader system, and accountability mechanisms ensure coordination across all levels.

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Supply chain resilience; multi-level resilience framework; middle-range theory; flood

## 1. Introduction

Supply chains are increasingly disrupted by unexpected disruptive events such as natural disasters, economic crises, and geographical conflicts (Fogliatto et al. 2025). These disruptions severely disturb material and goods flows, resulting in detrimental impacts on both operational and financial performance (Seif and Jafari 2026). For example, the 2024 Spanish floods created significant challenges for agri-food supply chains (AFSCs) across the country and wider Europe as extensive agricultural areas were submerged, while the COVID-19 pandemic affected 94% of Fortune 100 firms and led to the loss of approximately 250 million full-time jobs worldwide (Faruquee, Paulraj, and Irawan 2024a). In the face of increasingly frequent supply chain disruptions that threaten business continuity, the concept of supply chain resilience (SCRes) has attracted significantly scholarly and managerial attention.

SCRes refers to a supply chain's adaptive capability to prepare for, respond to, recover from, and adapt after unexpected disruptions (Kamalahmadi and Parast 2016). Studies have defined and developed various SCRes models and frameworks, explored its principles, capabilities, and antecedents, and measured and assessed it (Ponomarov and Holcomb 2009; Scholten, Scott, and Fynes 2014). For example, Adobor and McMullen (2018) construct an overall SCRes framework that considers engineering, ecological, and evolutionary resilience, while Adobor's Adobor (2019) multi-level resilience framework includes employees, firms, and

supply chain. Wieland and Durach (2021) develop a theoretical understanding of SCRes and define it from engineering, social, and ecological perspectives. Novak, Wu, and Dooley (2021) equilibrium-based conceptualisation of SCRes frames it as a system continuously adapted and transformed by the autonomous actions of actors within the system, and Zhao, Zuo, and Blackhurst (2019) define SCRes from a network perspective and propose that its successful establishment requires restructuring, adaptation, or reconfiguration of the supply chain network. Other scholars, such as Kochan and Nowicki (2018) and Shishodia et al. (2023), have sought to revolutionise SCRes by linking capabilities, strategies, mechanisms, phases, and outcomes. Although existing studies have sought to conceptualise SCRes from a systems perspective and have begun to propose multi-level frameworks, the phenomenon remains insufficiently understood (Ivanov 2024; Stadtfeld and Gruchmann 2024). SCRes is inherently dynamic, multi-level, and processual (Ahmed et al. 2025); however, existing research has predominantly focused on organisational and supply chain levels, often overlooking the critical roles of individual actors and broader environmental or institutional contexts (e.g. Shen and Sun 2023; Nibbrig, Azadeh, and Maknoon 2025). Moreover, cross-level interactions are rarely considered, which may lead scholars and practitioners to overlook the dynamic and multi-scalar nature of SCRes. As Adobor (2019) notes, failing to account for cross-level interactions across different levels of a supply chain omit factors that may ultimately explain what determines resilience at the

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supply chain level. Furthermore, examining cross-level interactions enables a shift away from reductionist logic towards a more holistic perspective, treating the supply chain as a more closed system (Wieland 2021). While some studies have advanced multi-level conceptualizations of SCRes, these contributions are largely theoretical. Empirically grounded frameworks that explicitly articulate the role of each level and importantly, explain how these levels interact and collectively contribute to resilience across different stages remain scarce. As Senna et al. (2023) argue, without a comprehensive examination of how multiple levels jointly prepare for, respond to, recover from, and adapt to disruptions, SCRes remains difficult to operationalise in practice and continues to pose unresolved theoretical challenges. This gap underscores the need for empirically validated, process-oriented multi-level frameworks capable of explaining not only what enables SCRes, but also how resilience unfolds across interconnected actors and stages.

On this backdrop, the present study aims to develop a multi-level, processual understanding of how individual, organisational, supply chain, and environmental levels interact and collectively contribute to SCRes across the stages of preparation, response, recovery, and adaptation. Adopting a multi-level perspective enables a deeper understanding of the consequences and opportunities arising from changes at different levels. This, in turn, provides insights into how organisations can capitalise on these changes by reconfiguring accumulated resources to achieve coordinated actions with other organisations within the supply chain, thereby transforming SCRes (Mirzabeiki and Aitken 2023). Accordingly, we formulate four research questions to develop new insights into SCRes: (1) what organisational and SCRes strategies were employed to prepare for, respond to, recover from, and adapt to disruptions; (2) which personal traits facilitate the effective implementation of specific organisational and SCRes strategies; (3) under what contextual conditions do individuals, organisations, and supply chains achieve cross-level synergies in preparing for, responding to, recovering from, and adapting to disruptions; and (4) how these multi-levels collectively interact to contribute to SCRes. Using an inductive multiple case study approach, we explore the resilience dynamics of AFSCs in the context of the 2021 Henan floods. This context was chosen because it can be characterised as a catastrophic, record-breaking urban flood disaster in central China, and Henan's agri-food industry demonstrated remarkable resilience in response. Insights from this context therefore provide a rich empirical foundation for theorising AFSC resilience. Drawing on 54 semi-structured interviews, this study develops a multi-level framework to explain how AFSC stakeholders collectively achieved resilience in the aftermath of the floods. We used middle-range theory (MRT) to capture the many levels involved in SCRes building and interactions between them. MRT is frequently used to obtain deeper, more contextualised understandings of mechanisms linking specific events.

We make several contributions to theory and knowledge. First, we enrich SCRes from a systems perspective. We develop a multi-level SCRes framework that takes account of

its dependence on the collective efforts of individuals, organisations, supply chains, and environments across the four phases of preparation, response, recovery, and adaptation. Our delineation shows how different levels play differing roles in establishing the SCRes. The environmental level provides sustainable financial, technological, and policy resources to disrupted organisations and supply chains until they manage to adapt; the supply chain level sets preparation, response, recovery, and adaptation goals for disrupted organisations; the organisational level disseminates the resilience goals horizontally and vertically; and the individual level implements the various organisational and SCRes strategies. These arrangements alone do not ensure coordinated action; rather, the invisible forces of China's hierarchical cultural value orientation, accountability mechanisms, and associated chain leader system foster synergies across different levels of the supply chain. Second, successful implementation of organisational and SCRes strategies depends on appropriate individuals. When selecting individuals to deliver resilience strategies, our analysis reveals 11 personal traits that should be considered: courage, energy, flexibility, ambition, extraversion, conscientiousness, persistence, openness, curiosity, reliability, and loyalty. Employees characterised by openness and extraversion are particularly useful in the recovery and adaptation phases because they have expertise in networking with people, and can thus build assistance networks and obtain resources to support their development. Finally, our results encourage a systems understanding of supply chain management (SCM) issues in specific environments to produce rich and actionable insights. We also respond to calls to explore use of MRT to advance SCM research and to understand SCRes from a systems perspective (Wieland 2021; Wieland and Durach 2021; Craighead, Cheng, and Ketchen 2024).

## 2. Literature review

In this section, we review the SCRes literature and present the theoretical framework that guided our empirical study. We also identify research gaps offering avenues for future research.

### 2.1. SCRes definitions

Christopher and Peck (2004) defined SCRes from a systems perspective, referring to it as a system's ability to return to its original state or move to a better state after being disturbed. However, this early definition lacks clarity regarding SCRes capabilities, phases, antecedents, and consequences (Kochan and Nowicki 2018). Subsequent research has provided a more comprehensive understanding. For example, Ponomarov and Holcomb (2009) consider SCRes to be supply chains' adaptive capability, achieved by establishing connectedness between supply chain partners and maintaining control over structure and function throughout the preparedness, response, and recovery phases in the face of unexpected events. Ponis and Koronis (2012) highlight several important elements for building SCRes, including supply chain networks, proactive planning, responding adaptively,

robust post-event of operations, a favourable state, and competitive advantage. Tukamuhabwa et al. (2015) criticise previous studies for trying to incorporate more elements into SCRes yet neglecting cost-effectiveness. They complement previous SCRes definitions by adding timely and cost-effective recovery. Finally, Wieland and Durach (2021) conclude that resilience can only be achieved within each subsystem of supply chains, such as engineering resilience and socio-ecological resilience.

## 2.2. SCRes phases in the context of broad disruptions and natural disasters

Several SCRes phases are widely discussed by scholars. For example, Kamalahmadi and Parast (2016) highlight three phases: the anticipation phase of preparing for expected and unexpected changes in the environment, the resistance phase of resisting and deactivating the perturbation before it expands, and the response and recovery phase of minimising the negative impacts of supply chain disruptions and restoring firms' operations. Adobor (2020) describes SCRes as a complex adaptive system with four phases: exploitation, conservation, release, and reorganisation. This framework suggests that resilient systems do not simply return to their pre-disruption state; rather, they develop new resilience regime at each phase while retaining selected elements to ensure continuity and learning. As Holling et al. (2002) argued, resilience systems move towards reorganisation, as this phase allows for experimentation and innovation. By leveraging accumulated resources within the system such as economic and social capital, organisations can develop new structures, strategies, or relationships that enhance long-term adaptability and sustainability. Thus, existing supply chain systems may be deconstructed and renewed through the redesign, redistribution, reorganisation, and reallocation of resources across the entire system. According to Tukamuhabwa et al. (2015), SCRes should include the four phases of preparation, response, recovery, and adaptation. The preparation phase refers to the proactive measures taken to anticipate and avoid potential threats, while the adaptation phase involves adapting and transforming supply chains to a new or better state in the shortest time at the least cost. Besides these four widely accepted SCRes phases, Nikookar, Stevenson, and Varsei (2024) suggest including post-disruption growth, which helps supply chains to achieve long-term competitive advantage.

In addition, several scholars have examined SCRes phases specifically in relation to natural disasters. For example, in the context of weather-related disasters, Drozdibob et al. (2023) proposed a five-phase framework comprising preparation, initial response, stagnation, reconstruction, and mitigation. In the context of floods, Sodhi and Tang (2014) proposed a four-phase disaster management approach comprising: (1) mitigation, which involves identifying flood-prone areas and preventing development within them; (2) preparedness, referring to pre-flood planning and relief preparation; (3) response, which entails developing and implementing solutions to address disruptions; and (4)

recovery, focusing on restoring business operations disrupted by floods. Linnenluecke, Griffiths, and Winn (2012) conceptualised a six-phase framework including anticipatory adaptation, disaster sensemaking, response, reconstruction, restoring, and sensemaking and learning. Similarly, Scholten, Scott, and Fynes (2014) developed a four-phase framework encompassing preparation, immediate response, recovery, and mitigation, while Lawther (2016) argued that, in the face of natural disasters, SCRes involves four phases: response renewal, replacement, enhancement, recovery and adaptation. Although existing studies have proposed various SCRes phases in the context of natural disasters, they generally converge on four key phases: preparation, response, recovery, and adaptation. However, several studies have made exceptions. For example, Sodhi and Tang (2014) suggested that the first SCRes phase is mitigation. In this study, we did not adopt mitigation as the first phase because climate change has made flooding events increasingly difficult to predict, with floods now occurring in regions previously considered low risk, as exemplified by the 2021 Henan floods. Linnenluecke, Griffiths, and Winn (2012) identified sensemaking and learning as the final phase, which aligns with this study conceptually, although expressed differently. While Drozdibob et al. (2023) proposed additional intermediate phases, these can largely be subsumed under the broader categories of response and recovery. Consistent with prior studies and considering the flood-related context of this research, we adopt four phases of SCRes: preparation, response, recovery, and adaptation.

## 2.3. Multi-level contributions to SCRes

Many scholars have considered SCRes from organisational and supply chain perspectives, but few have examined it from a systems perspective (Pettit, Croxton, and Fiksel 2019). For example, from a social-ecological perspective, Statsenko, Jayasinghe, and Soosay (2024) develop a multi-level resilience framework encompassing the organisational, supply chain, and industry levels. They argue that a supply network's ability to anticipate and prepare for disruptions is positively influenced by organisation's visibility and flexibility. Moreover, supply network response velocity is enabled by inventory redundancy and process flexibility at the organisational level, as well as visibility and collaboration at the supply chain level. At the industry level, institutional support enhances the supply network's capacity to reorganise following disruptions. Drawing on their investigation of SCRes to environmental shocks (e.g. extreme rainfall), Davis, Downs, and Gephart (2021) propose that responses to disruptions can be implemented across individual, organisational, and institutional levels. Table 1 presents an overview of prior studies that conceptualise SCRes from a systemic perspective. Consistent with prior studies that adopt a systems-thinking approach to conceptualising SCRes, and recognising that supply chains are composed of individuals and organisations that are themselves influenced by external political, economic, social, technological, environmental, legal, and cultural (PESTELC) environments, this study views SCRes as a

**Table 1.** Overview of studies addressing SCRes from a systemic perspective.

Studies	Systemic understanding of SCRes	Empirical/Conceptual
Fiksel (2016)	SCRes as environmental and community resilience	Conceptual
Adobor and McMullen (2018)	SCRes as engineering, ecological, and evolutionary resilience	Conceptual
Adobor (2019)	SCRes as a multi-level framework encompassing individual, organizational, and inter-firm levels	Conceptual
Pettit, Croxton, and Fiksel (2019)	SCRes can be understood as an emergent property of dynamic systems that integrate economic, social, and environmental dimensions	Conceptual
Davis, Downs, and Gephart (2021)	SCRes could be achieved through the collective efforts between, individual, organizational, and institutional levels	Empirical
Novak, Wu, and Dooley (2021)	SCRes is a complex adaptive system that continually adapts and transforms via autonomous actions of the different actors within the system	Conceptual
Wieland (2021)	SCRes as a socio-ecological system's resilience, encompassing supply chain, political-economic, and planetary levels	Conceptual
Wieland and Durach (2021)	SCRes is a system's capability encompassing engineering resilience and social-ecological resilience	Conceptual
Statsenko, Jayasinghe, and Soosay (2024)	SCRes as a multi-level framework, encompassing organizational, supply chain, and industry levels	Conceptual
Tsvetkova and Gammelgaard (2025)	SCRes can be understood as a form of socio-ecological resilience, the achievement of which depends on the interactions between social and natural systems	Empirical

multilevel phenomenon. From this perspective, SCRes is shaped by environmental, supply chain, organisational, and individual factors, and it is the interactions among these levels that collectively determine SCRes. In [Appendix A](#), we summarise the empirical contributions of individual, organisational, supply chain, and environmental factors to achieving SCRes.

### 2.3.1. Organisational level capabilities contributing to SCRes

At the organisational level, several capabilities are identified as having positive effects in establishing SCRes, including long-term planning, internal knowledge sharing, creation of new knowledge, use of technology, organisational learning, culture and leadership, and investment finance and cash flows (Gu et al. 2023; Sahebjamnia, Torabi, and Mansouri 2018). Küffner et al. (2022a) empirical evidence suggests that real-time adaptation of operations, decision acceleration, increased collaboration, data privacy and security, and goal compatibility are key organisational capabilities for SCRes enhancement. A significant positive relationship has been found between organisational learning, agility, innovativeness, and SCRes (Eryarsoy et al. 2022), and Roh et al. (2022) find that organisational absorptive capacity determines high- or low-impact SCRes. Based on resource orchestration theory, Li et al. (2020) highlight that an organisational risk management culture and effective internal resource integration contribute to SCRes. Organisations are subsystems within supply chains, and when certain organisational processes and resources are embedded at the organisational level, then organisations can establish resilient behaviours and resilience capabilities, further activating SCRes.

### 2.3.2. Supply chain level capabilities contributing to SCRes

At the supply chain level, most proposed SCRes capabilities relate to flexibility, redundancy, trust, information sharing, visibility, velocity, leadership, and innovation. For example,

Scholten and Schilder (2015) explore SCRes from a collaboration perspective and identify the influence of decision synchronisation, resource sharing, incentive alignment, mutually created knowledge, and mutual dependency. Similarly, Ramos et al. (2025) argue that high levels of collaboration, trust, and information sharing among supply chain partners are critical for developing SCRes. Jain et al. (2017) identify 13 SCRes capabilities, including risk and revenue sharing, supply chain structure and memory, market sensitiveness, and technological capability among partners. In the context of disasters such as the Nepal earthquake, Papadopoulos et al. (2017) suggest that swift trust, information sharing, and public-private partnerships are critical enablers of SCRes. While these studies offer valuable directions for building SCRes, they provide limited guidance for practical implementation. Accordingly, Senna et al. (2023) suggest that maintaining buffer inventory, establishing crisis response team, and cross-training employees can positively influence SCRes. In the face of supply chain disruptions particularly those caused by natural disasters, the responses and recovery processes are especially challenging due to the involvement of multiple stakeholders and the need to coordinate activities across different levels (Hussain et al. 2023). Therefore, developing capabilities solely at the supply chain level is insufficient, as delays can exacerbate damage over time. Instead, effective coordination among all stakeholders across multiple levels is critical for building adaptive capacity. As noted by Gabler, Richey, and Stewart (2017), resilience to natural disasters involves the collective response of individuals, businesses, non-profit organisations, and multiple levels of government; therefore, disasters necessitate cross-level collaborations to stimulate SCRes.

### 2.3.3. Environmental effects on SCRes

Environmental dynamism can drive the need for proactive SCRes capabilities by compelling supply chain partners to continuously monitor, anticipate, and project potential environmental changes through early detection (Faruquee, Paulraj, and Irawan 2024b). Thus, at the environmental level,

scholarly interest has focused particularly on the impact of the technological environment on SCRes. Information technologies may positively influence SCRes, and artificial intelligence may enhance transparency, ensure last-mile delivery, offer personalised solutions, and facilitate an agile procurement strategy (Modgil, Singh, and Hannibal 2022). The internet-of-things, blockchain, and machine learning may also benefit supply chain visibility and contribute positively to SCRes (Qader et al. 2022). With regard to understanding SCRes from other environmental perspectives, Zhao et al. (2024a) explore the impact of a country's cultural value orientation on organisational and SCRes. Their results indicate that a hierarchical cultural value orientation has positive and negative effects on SCRes and organisational resilience, respectively. Conversely, an egalitarian cultural value orientation has positive effects on organisational resilience, but poses threats to SCRes. Ramos et al. (2025) highlight that a shared risk management culture extending beyond corporate boundaries can play a significant role in enhancing SCRes. Based on dynamic capability and contingency theories, Song et al. (2022) highlight that with conducive government policies, a risk management culture, and trusting and cooperative environments, firms' logistical capabilities can be transformed into integrated supply chain logistics capabilities, and thus contribute to SCRes.

#### 2.3.4. Individual level contributions to SCRes

At the individual level, very few studies have investigated how personal attributes can contribute to SCRes. For example, Adobor (2019) proposes an SCRes framework comprising individual, organisational, and supply chain levels, and identifies that individuals' learning orientation, trusting disposition, and self-leadership are three key attributes for building SCRes. Based on data from 229 manufacturing firms, Durach and Machuca (2018) confirm that personal attributes such as interpersonal skills and interpersonal complementarity are significant antecedents of organisational resilience. Gerschberger, Ellis, and Gerschberger (2023) find indicates that employees' cognitive (situational assessment, experience, commitment, and sensemaking), emotional (emotional fortitude, empowerment, and psychological safety) and behavioural attributes (preparedness, resourcefulness, and improvisation) contribute to organisational resilience.

#### 2.3.5. Cross-level interactions in building SCRes

As for cross-level interactions in building SCRes, relatively few studies have explored this topic. However, some relevant contributions can be identified. For example, Adobor (2019) suggests that organisational context (e.g. psychological safety) reflects interactions between the individual and organisational levels, while inter-firm factors (e.g. trust and collaboration) and supply chain orientation capture interactions between the organisational and supply chain levels. Wieland (2021) proposes that cross-level linkages are critical, as they exert mutual impact across different levels. In particular, "revolt" linkages describe how critical changes in a smaller cycle can cascade to larger cycles, which is

especially relevant for interactions between supply chain and political-economic levels. "Remember" linkages influence the manner of reorganisation by embedding past experiences and knowledge, which is particularly important for interactions between political-economic and planetary levels. Vural et al. (2025) provides a more detailed account of cross-level linkages, identifying new product development and resource reconfiguration as key mechanisms through which interactions across levels are enacted. Other studies, such as Mirzabeiki and Aitken (2023), suggest that changes in politics and legislation act as cross-level linkages between planetary and political-economic levels, while shifts in consumers' food spending function as linkages between the individual and organisational levels. Our analysis of existing SCRes studies indicate that cross-level interactions can be understood as either contextual conditions or mechanisms that bridge boundaries across different levels, typically accompanied by the mobilisation of information, knowledge, or resources.

#### 2.4. Research gaps

Our comprehensive review of the SCRes literature reveals two significant research gaps that open important avenues for future inquiry. Specifically, existing studies tend to conceptualise SCRes either from a single-level perspective or by integrating two or, in rare cases, three levels of analysis. As shown in Appendix A, among the 41 empirical studies identified, 27 (65.8%) examine SCRes at a single level, 13 (31.7%) integrate two levels, and only one study (2.5%) attempts to advance SCRes by incorporating three levels. For example, Nikookar, Stevenson, and Varsei (2024) emphasise the importance of ontological, analogical, and identity levels in developing an antifragile supply chain. Similarly, Chopra, Sodhi, and Lückner (2021) investigate multi-level commons including within-company, private across-company, and government-sponsored across industry sectors to enhance SCRes. While these studies represent important advances, they remain limited in scope. Moreover, although several studies (see Table 1) attempt to conceptualise SCRes from a systems perspective, most are primarily theoretical rather than empirically grounded. To the best of our knowledge, no study has developed a processual and empirically validated understanding of SCRes that simultaneously integrates individual, organisational, supply chain, and environmental levels across different resilience phases. Accordingly, the interactions among these multi-levels have also been rarely examined in the literature. This integrative, process-oriented investigation therefore extends existing research by theorising how multiple levels interact dynamically throughout preparation, response, recovery, and adaptation, thereby offering a more comprehensive explanation of SCRes development.

#### 2.5. MRT to build SCRes

To fill the above research gaps, we adopted MRT. MRT is particularly suited to this study for several reasons. First, MRT focuses on consolidating knowledge within a specific domain (Pinder and Moore 1979). For example, in this

study we aimed to extend our understanding of SCRes, a well-established area that has received considerable scholarly attention and in which substantial qualitative empirical evidence has accumulated over time. Second, an essential aspect of using MRT is that it should be built directly on established knowledge within that domain. Previous scholars have built diverse multi-level SCRes frameworks (e.g. Adobor 2019; Wieland and Durach 2021). In this study, we posit that achievement of SCRes depends on the collective efforts of individuals, organisations, supply chains, and environments. Third, MRT focuses on specific mechanisms that produce outcomes in a particular context (Pellathy et al. 2018). In this study, we use it to understand how individuals, organisations, supply chains, and environments collectively prepared for, responded to, recovered from, and adapted after floods in China. We aimed to gain insight into why and how different levels of the resilience framework are related, and the conditions in which their interactions are useful for building SCRes.

As depicted in Figure 1, our formulation of a theoretical framework began with empirical evidence on SCRes to build relationships between disruptions and SCRes. Thus, we reviewed existing studies on SCRes, including SCRes definitions, resilience phases, and multi-level contributions to SCRes. In particular, we examined literature on cross-level interactions in building SCRes. Accordingly, we posited that the devastating effects of disruptions might facilitate supply chains' development of SCRes. We then established mechanisms to understand how supply chains improved their resilience in the face of disruptions. Individuals and organisations are the basic components of a supply chain, and we posited that their collective efforts across preparation, response, recovery, and adaptation phases would foster SCRes. Rich, actionable insights to SCRes could only be obtained by understanding this phenomenon in specific contexts (Craighead, Cheng, and Ketchen 2024). Thus, we posited that China's PESTELC environments elicit resilient individual behaviours, specific organisational strategies, and resilience capabilities, resulting in SCRes. Finally, we used Stank et al. (2017) framework of *contexts + mechanisms = outcomes* to generate a holistic understanding of SCRes, in the belief that achievement of SCRes depends on the collective efforts of individuals, organisations, supply chains, and environments across preparation, response, recovery, and adaptation phases.

### 3. Research methodology

Due to their novelty, the 2021 Henan flood offers a valuable opportunity to study how multi-levels of a supply chain interact and collectively contribute to SCRes. An inductive research design was therefore followed, carrying out an exploratory study to build theory from case studies using naturalistic inquiry (Eisenhardt and Graebner 2007). More specifically, we adopted a multiple case study to explore the topic. Our unit of analysis was AFSCs affected by the 2021 Henan floods. Figure 2 illustrates our research methodology.

To ensure rigorous research, we applied four criteria relating to reliability and validity, as shown in Appendix B. Related issues are discussed in Sections 3.1 to 3.3 below.

### 3.1. Sampling process

#### 3.1.1. Research context: China's Henan province

Yin's Yin (2013) five rationales for single-case designs were used to justify selecting China's Henan province as the sole context for this study. The first rationale for a single-case study is that it is a *critical* case for testing a well-formulated theory. In this study, we used MRT to explore the topic. These are well-established theories with clearly defined processes. For instance, Craighead, Cheng, and Ketchen (2024) develop a five-step process for high-quality middle-range theorisation. Henan province, China's major agricultural region, experienced two flooding events. Successful recovery and adaptation following these events required collective efforts by individuals, organisations, AFSCs, and their associated environments, thereby meeting the requirement to test, confirm, challenge, or extend MRT. The second rationale is that the case is an *extreme* or *unique* case. Our study focuses on SCRes, which consists of preparation, response, recovery, and adaptation. Adaptation involves summarising, learning, and internalising experiences of tackling disruption and preparing for future disturbances. A supply chain will have experienced a full SCRes cycle only after successfully surviving two similar disruptive events. Methodological rigour requires identification of a supply chain that has undergone a complete SCRes cycle. Thus, we checked FloodList (<https://floodlist.com/>) to identify places that had experienced two flooding events in recent years. China's Henan province experienced two floods between 2021 and 2023 (see Appendix C), and was thus a potential place in which to collect our empirical data. The third rationale is the *representative* or *typical* case. Having recently experienced two flooding events, we assumed that Henan's AFSC practitioners must possess sufficient knowledge to address similar events effectively in future. We expected the lessons learned from these flooding events to provide valuable insights for both academics and practitioners. The fourth rationale is that the case is *revelatory* case, requiring investigators to observe and analyse previously inaccessible phenomena. Flooding is becoming more frequent due to climate change, yet few scholars have conducted field visits to China's Henan province to investigate how disrupted enterprises recover from such events. Our study exemplifies how future empirical investigations might be carried out in relation to floods. The last rationale is that the case is *longitudinal*, requiring investigators to study the phenomenon at two or more points in time. Funded by the UK's Royal Society, we visited Henan province several times between 2022 and 2023, which provided us with sufficient opportunities to visit disrupted enterprises and discuss with associated practitioners.

We developed a timeline to facilitate understanding of the SCRes cycle between 2021 and 2023 (see Figure 3). The cycle was categorised into the four phases of preparation, response, recovery, and adaptation based on the timeline of events. We categorised the period prior to 20 July 2021 as the preparation phase, because fire & rescue authorities and armed forces started their emergency assistance from this day. The period between 20 and 25 July 2021 was considered to be the response phase, because technical guidance

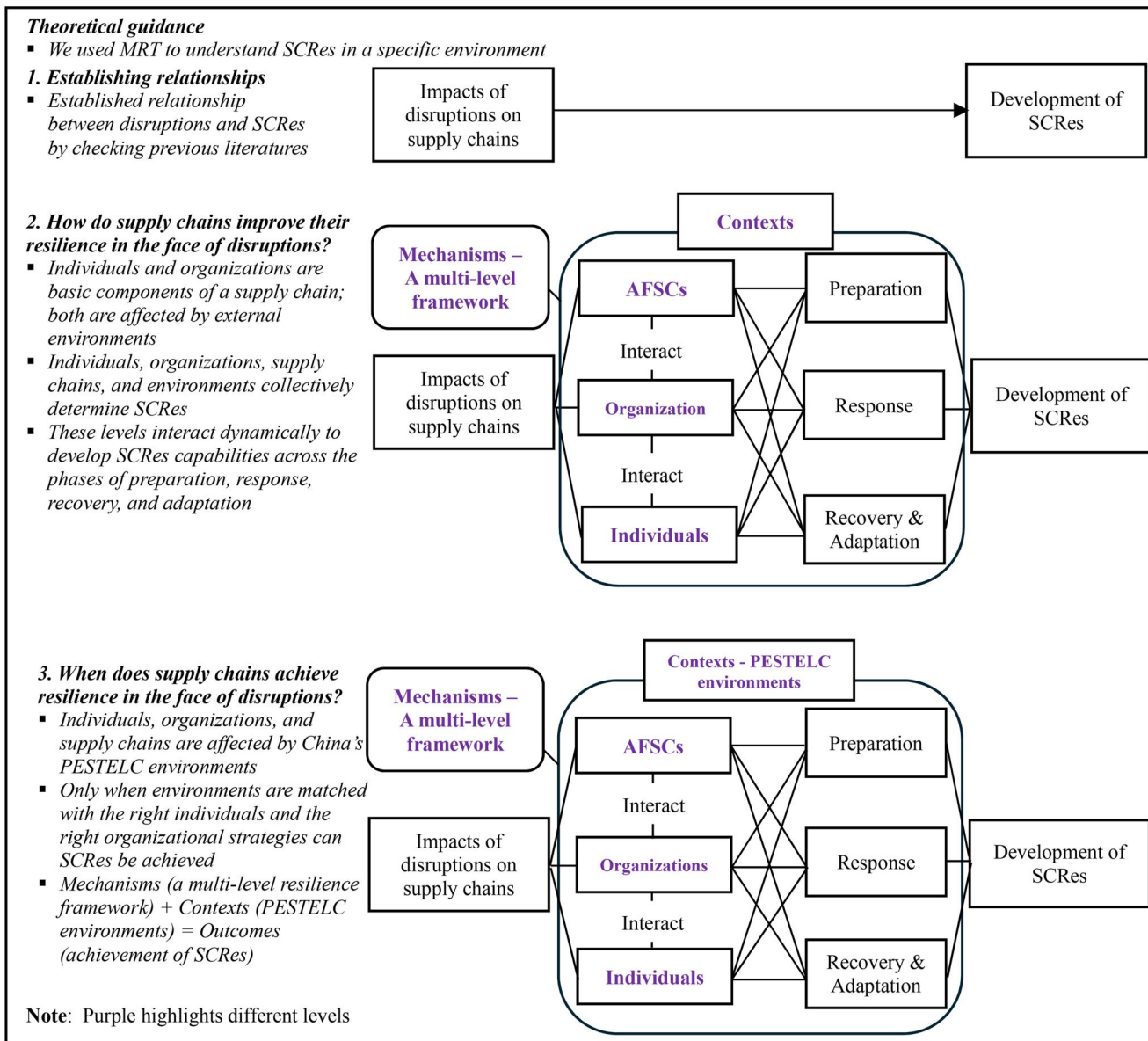


Figure 1. MRT-enabled theoretical framework.

for post-disaster agricultural production was issued on 25 July. We considered the period from 25 July to 5 November 2021 to be the recovery phase, because the water withdraw from farms' food storage was almost complete by then, allowing AFSC practitioners to prepare for further improvements. Between 5 November 2021 to 31 August 2023, several important reports, including a reconstruction plan, were released for adaptation purpose, and Henan was flooded again. Accordingly, we considered this period to be the adaptation phase.

### 3.1.2. Selection of AFSCs, agri-food organisations, and participants

We began by selecting AFSCs that were impacted by the 2021 Henan floods. Henan has long been a major agricultural province in China, ranking first nationally in wheat production and pig farming, second in vegetable production and total grain output, and third in meat, egg, and dairy

production (National Bureau of Statistics 2025). Based on our professional connections and recommendations from three professors in Henan province with expertise in soil water content, agricultural machinery, and SCM, we selected two AFSCs focused on vegetable production, processing and distribution. To map these two AFSCs, we initially visited a local supermarket with extensive connections to the regional agri-food industry to identify its vegetable suppliers and associated logistics service providers and processors.

Through this initial mapping, a list of 20 companies spanning farming, processing, and logistics services was generated. We then narrowed the list by applying two selection criteria. First, only medium-sized and large companies with an annual turnover of at least ¥50 million were considered, as such firms are more likely to have possess the influence to coordinate with other firms and to have implemented risk management strategies at the supply chain level (Polyviou, Croxton, and Knemeyer 2019). Second, the selected organisations needed to have experienced a complete SCRes cycle

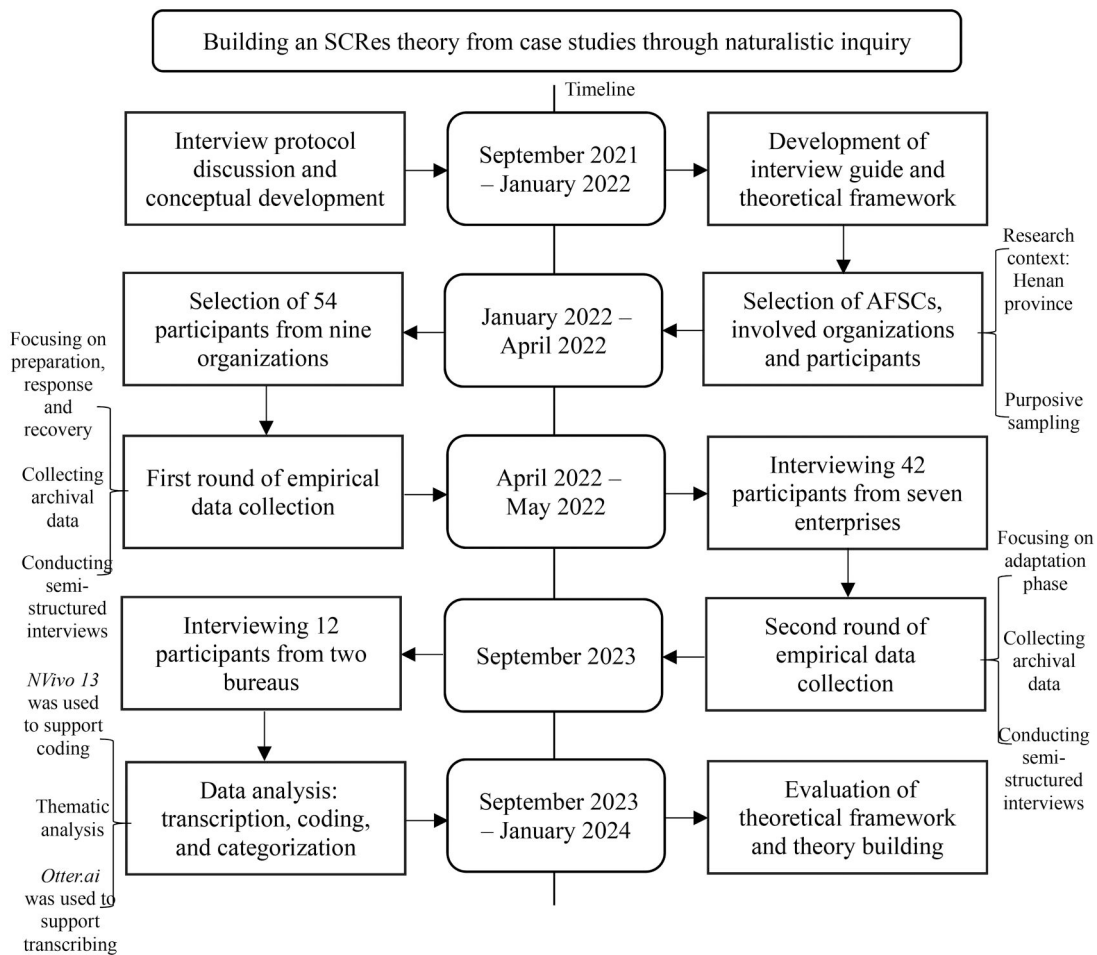


Figure 2. Research methodology adopted.

and survived both two flood events. Based on these criteria, 15 companies were excluded, resulting in each AFSC comprising one vegetable cultivation company and one vegetable processing company. These two AFSCs share the same cold chain logistics and sell their products to the same supermarket. Cold chain logistics involves significant capital and operational investments due to the need for continuous temperature control throughout the supply chain. Therefore, vegetable production and processing companies tend to collaborate with regional key cold chain logistics hubs. The supermarket operates 21 chain stores across different areas of Henan province is therefore prioritised as a key outlet for selling their vegetables. Furthermore, the role of the Chinese government in the recovery process could not be overlooked. Therefore, three governmental organisations, including the local Water Conservancy Bureau, Emergency Management Bureau, and Agricultural and Rural Affairs Bureau, were also included in the analysis.

Next, we disseminated our project information widely through WeChat (e.g. groups) to attract potential respondents from the selected two AFSCs. This resulted in our initial identification of 92 interviewees. We further developed three criteria to reduce the number of respondents through purposive sampling, a method used to intentionally select respondents based on specific characteristics, expertise, or experiences relevant to the phenomenon under

investigation. First, they should have been directly involved in helping AFSCs to respond to and recover from the 2021 Henan floods. Second, we required senior-level management team respondents who understood their external environments, department managers responsible for overseeing all functions of particular business units, and ground-level workers responsible for coordinating and delegating tasks to ensure efficient processes. Third, the respondents should have had more than 10 years' working experience in the agri-food industry to ensure high expertise and sufficient knowledge. Based on these criteria, 54 respondents were selected for interviews. Table 2 provides details on the interviewees.

### 3.2. Interview protocol and empirical data collection process

We developed an interview protocol through three online discussions and frequent email communications with four senior SCM academics. Accordingly, we produced an initial version of our interview guide and spent a month conducting pilot interviews with six AFSC practitioners to evaluate our SCRes framework and ensure the clarity and comprehensibility of the interview guide for our potential interviewees. Based on the pilot interviews, we reworded some questions and added more examples to enhance clarity. Our interview

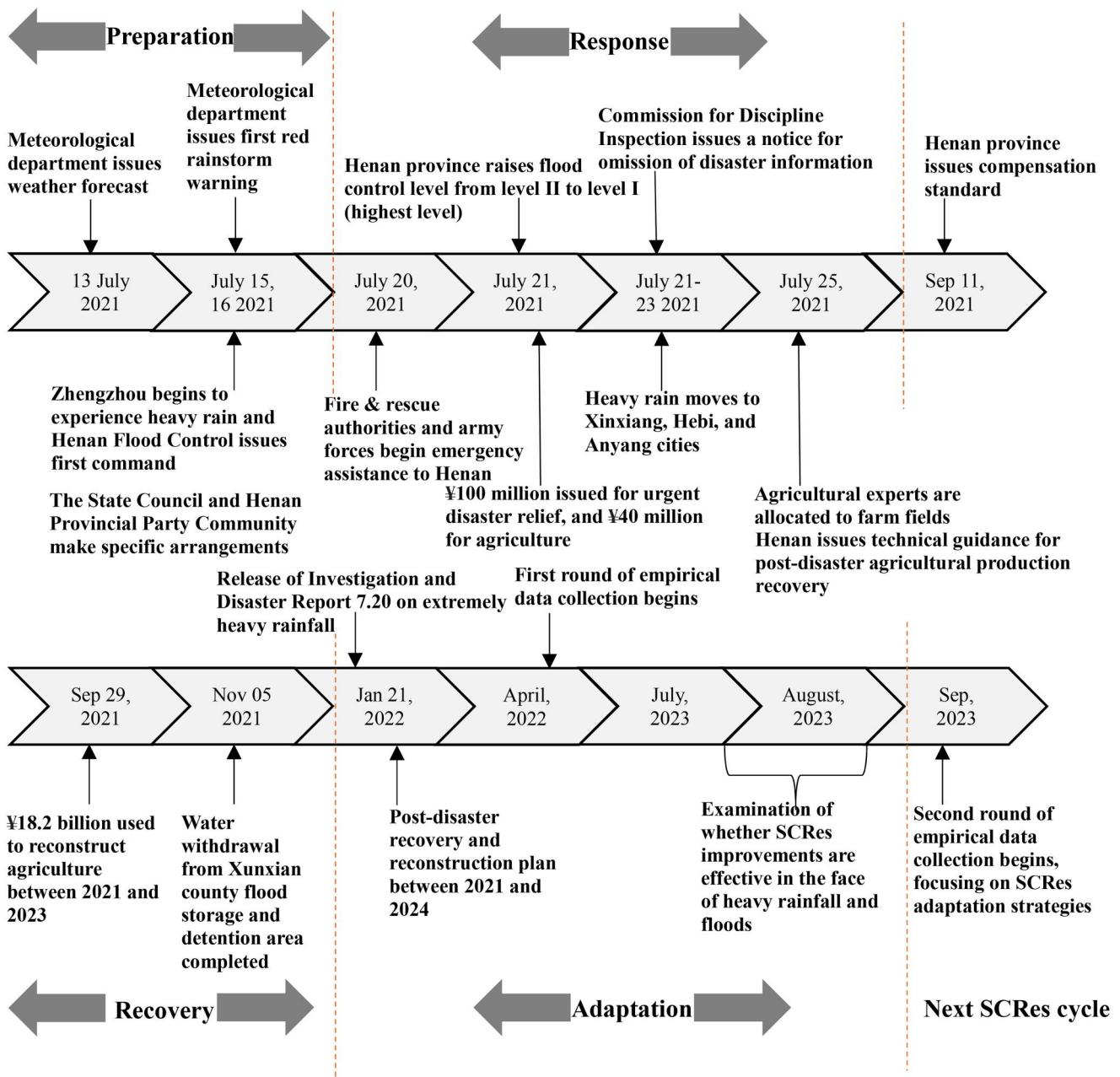


Figure 3. SCRes cycle and associated flooding events, 2021–2023.

guide comprised two sections, the first gathering information on the interviewee and the company, and the second focusing on SCRes (see Appendix D).

We conducted two rounds of empirical data collection. In the first, beginning in April 2022, we interviewed participants from AFSCs, focusing on preparation, response, and recovery. We paid less attention to the adaptation phase at this stage because adaptation strategies and their effectiveness would be evaluated against later similar events. In the second round, beginning August 2023, we interviewed participants from governments, enabling a thorough understanding of the four SCRes phases. A copy of the interview guide was sent to the interviewees through WeChat three days prior to the interview session, which provided them with sufficient time to familiarise themselves with the structure and research questions, and to prepare and organise their

answers. The research team who conducted interviews in China comprised two experienced qualitative scholars fluent in Chinese, one of whom focused on asking questions while the other took notes relevant to our research questions. To avoid missing any valuable information, we recorded these interviews with the interviewees' permission. At the end of each interview, we asked interviewees to check our notes to ensure that we had not misunderstood. All interviews were conducted on-site and lasted on average 80 minutes, although some lasted more than 120 minutes. We continuously adapted our research questions when misunderstandings occurred.

To complement our interview data, we also collected archival data from government reports, company websites, company news, and industry reports (see Appendix C). Thus, information from the disaster investigation report on

**Table 2.** Interviewees information.

	Company (number of interviewees)	Interviewee (department and title)	Interview date
AFSC (I)	State-owned farm (6) (A)	Industrial Management Department (Manager) (A1) Marking Department (Manager) (A2) Community Working Department (Employee) (A3) General Management Department (Employee) (A4) Development Planning Department (Manager) (A5) Stated-owned Farm (General Manager) (A6)	April 2022
	Vegetable cultivating and processing (6) (C)	Company Party Committee Office (Manager) (C1) Operations Management Department (Manager) (C2) Administration Department (Manager) (C3) Operations Management Department (Employee) (C4) Vegetable Cultivating and Processing Company (Deputy General Manager) (C5) Quality Management Department (Employee) (C6)	
AFSC (II)	State-owned farm (6) (B)	Department of Safety and Emergency Affairs (Manager) (B1) Department of Safety and Emergency Affairs (Employee) (B2) Operations Management Department (Manager) (B3) Administration Department (Manager) (B4) Department of Social Affairs (Manger) (B5) Production Materials Department (Manager) (B6)	May 2022
	Vegetable cultivating and processing (6) (D)	Administration Department (Manager) (D1) Operations Management Department (Manager) (D2) Risk Control Department (Manager) (D3) Agricultural Equipment Department (Manager) (D4) Quality Management Department (Manager) (D5) Vegetable Cultivating and Processing Company (Deputy General Manager) (D6)	
Common stakeholders between AFSC (I) and AFSC (II)	Cold chain logistics (6) (E)	Inventory Management Department (Manager) (E1) Regional Delivery Department (Manager) (E2) Packaging Department (Manager) (E3) Risk control department (Manager) (E4) Administration Department (Manager) (E5) Operations Management Department (E6)	June 2022
	Supermarket (6) (F)	Administration Department (Manager) (F1) Administration Department (Employee) (F2) Operations Management Department (Manager) (F3) Operations Management Department (Employee) (F4) Safety and Environmental Protection Department (Manager) (F5) Supermarket (General Manager) (F6)	July 2022
	Water Conservancy Bureau (6) (G)	Rural Water Conservancy Department (Chief) (G1) Water Resources Department (Chief) (G2) Construction and Management Department (Chief) (G3) Administration Department (Employee) (G4) Water Conservancy Bureau (Deputy Director) (G5) Water Resources Department (Employee) (G6)	August 2023
	Agricultural and Rural Affairs Bureau (6) (H)	Agricultural Disaster Prevention and Mitigation Department (Chief) (H1) Agricultural Investment Management Department (Chief) (H2) Quality Management Department (Chief) (H3) Agricultural and Rural Talents Department (Chief) (H4) Agricultural and Rural Affairs Buerue (Deputy Director) (H5) Agricultural Disaster Prevention and Mitigation (Employee) (H6)	September 2023
	Emergency Management Bureau (6) (I)	Disaster Relief and Material Support Department (Chief) (I1) Administration Department (Chief) (I2) Policy and Regulation Department (Chief) (I3) Emergency Management Bureau (Deputy Director) (I4) Department of Technology and Information (Chief) (I5) Disaster Relief and Material Support Department (Employee) (I6)	October 2023

response strategies to be implemented, adaptation strategies captured from relevant government websites, social media posts about the floods, and newspaper articles covering the keywords “resilience”, “risk awareness”, and “main lessons”, were all used to corroborate our interview data. Together, these archival resources revealed how individuals, organisations, and governments responded to the floods, thereby providing a broader and more nuanced perspective on the event than could be captured solely through interviews. We

adopted this methodological approach until we had gained a clear understanding of how individuals, organisations, supply chains, and environments collectively achieve SCRes.

### 3.3. Data analysis

We analysed our qualitative data using a rigorous, widely adopted, five-step procedure: transcribing, editing, coding,

categorising, and reporting. We uploaded the interview audio files to Otter.ai (<https://otter.ai/>) and initially transcribed them word-for-word to avoid missing any important information given by the interviewees. This resulted in more than 275 pages of transcripts from 82 hours of digital recordings. We then cleaned each transcript by removing irrelevant words and paragraphs. This resulted in 205 pages of transcripts remaining, with an average length of four pages.

During the open coding process, our objective was to understand collective efforts to achieve SCRes at individual, organisational, supply chain, and environmental levels, as well as links enabling them to achieve synergies. In doing so, we coded as many sentences and paragraphs as possible relevant to organisational and SCRes strategies that might be used to enhance SCRes, desirable personal attributes for implementing these strategies, and contributions from PESTELC environments fostering SCRes. The same two researchers who conducted the data collection activities in China also involved in the open coding process, given their expertise and direct involvement in the interviews. An initial coding framework was collaboratively developed and shared between them to establish a common interpretive foundation. Both researchers independently coded the first five transcripts and compared their interpretations. Any discrepancies were discussed and resolved through consensus, resulting in refined code definitions and clearer inclusion/exclusion criteria. Coding continued iteratively until no new themes or insights emerged across interviews. Although there are no universally accepted criteria for determining data saturation, prior studies have provided indicative ranges. For example, Hennink and Kaiser (2022) suggested that saturation is typically reached between 9 and 17 interviews or 4 and 8 group discussions, whereas Clarke and Braun (2019) argued that it may occur after 21–23 interviews, depending on the research objectives, sampling strategy, and data type. Given that this study aimed to develop a multi-level framework for SCRes, a conceptually complex topic, a larger sample was necessary to achieve saturation. After conducting 52 interviews with AFSC practitioners, recurrent references to personal traits such as extraversion and loyalty, and to SCRes strategies such as inter-organisational information sharing and government support, indicated that saturation had likely been reached. Two additional interviews were conducted to confirm this, and no new themes emerged, resulting in a total sample size of 54 interviews. Qualitative data analysis software *NVivo 13* was used to support data retrieval and management. To improve the transparency and trustworthiness of the analysis, we checked for intercoder reliability, with a score of 0.83, indicating substantial agreement between the coders (Landis and Koch 1977).

In the categorisation step, we first grouped codes with similar meanings and labelled them using established themes from both the SCRes literature and MRT. To saturate categories under development, we adopted an iterative approach, moving back and forth between relevant theory and data to refine codes and themes. More specifically, prior literature that provides the foundation of SCRes, such as

Christopher and Peck (2004), Adobor and McMullen (2018), and Wieland et al. (2023) guided our categorisation, while empirical studies that applied these theoretical themes (e.g. Zhao et al. 2024b) helped us make sense of them in this context. This iterative process also enabled us to examine and refine the links between inductive codes and constructs from the literature. Themes that share the similar values and goals were further categorised, which led to the development of aggregate dimensions capturing higher levels of abstraction in the coding. This step continued until a cohesive theoretical framework was developed to explain how supply chains prepared for, responded to, recovered from, and adapted to the floods through the collective efforts of individuals, organisations, supply chains, and broader environments. As Ketokivi and Choi (2014) noted, there is no universal applied criteria for determining when categorisation is complete; rather, it is reached when core categories that tie the study together are fully developed, relationships between codes, themes, and aggregate dimensions are established, and additional data no longer generate new properties, dimensions, or relationships.

Finally, we used King and Horrocks (2010) framework of first-order codes, second-order themes, and aggregate dimensions to present the results of our analysis. The findings were shared with all 54 participants via WeChat, and they confirmed that the identified themes accurately reflected their experiences and perspectives.

## 4. Findings

In this section we describe how individuals, organisations, supply chains, and environments managed to prepare, respond, recover, and adapt in the face of the 2021 Henan floods.

### 4.1. Preparation phase: lack of preparedness

Individuals, organisations, supply chains, and environments are identified as lacking preparedness in the face of the 2021 Henan floods owing to their joint impacts. First, from the natural environmental perspective, the rainstorm was long and extremely strong, with rainfall and floods on major rivers exceeding historical levels. One interviewee stated: “The total rainfall in 2021 was 1610.6 mm, 85.6% of which was concentrated from 11 July to 4 October. This was 2.7 times the average rainfall for many years.” The rainstorm’s extremely high intensity resulted in most urban and rural areas being quickly flooded, so individuals and organisations had insufficient time to prepare. Second, from the cultural environmental perspective, China has a particularly hierarchical cultural value orientation and relies on hierarchical systems to ensure responsible and productive behaviour. In this environment, people value social power, authority, and are expected to fulfil their obligations and implement tasks set by those in roles of greater status (Schwartz 2006). The hierarchical cultural environment amplified the detrimental effects of powerful people who paid insufficient attention to preparing for floods. For example, Henan’s meteorological department

issued a red warning of heavy rain on 13 July 2021, and the flooding occurred on 20 July. Individuals, organisations, and the whole society should have used this one-week period to prepare for the forecasting floods. However, they failed to do so because of powerful people's empiricism and poor sense of responsibility, saying "The rain in the North of China will not be heavy." For example, one interviewee stated: "Government leaders were satisfied with generic deployment, lacking concrete and effective measures for implementation." Another interviewee observed: "We were notified of the heavy rain and advised to take precautions, but we received no specific guidance or actionable instructions on how to do so." Consequently, not all enterprises received sufficient or actionable warnings regarding the severity of the rainfall, which limited their ability to implement effective preparatory measures. Third, from the technological environmental perspective, radio, television, newspapers, and new media platforms (e.g. live streaming, mobile media, and Weibo) were not effectively used to disseminate the red warning and flood prevention knowledge. One interviewee stated: "TV stations only broadcast the red rainstorm warning in routine weather forecasts five times between 19 and 20 of July." Moreover, meteorological forecasting and monitoring systems were unable to provide accurate forecasts on the areas likely to be affected and the intensity and duration of the storm, so individuals and organisations were reluctant to share this information. Finally, from the legal environmental perspective, various disaster management policies, rules, and regulations had already been released and should have been followed (see [Appendix C](#)). However, in most situations, individuals and organisations used their own experience to tackle the crisis.

At the supply chain level, AFSCs are identified as lacking preparedness for two reasons. First, organisations were unable to share uncertain information with their AFSC partners. One interviewee highlighted: "We were not allowed to share uncertain information with our supply chain partners, especially information on weather forecasting results. How would we have dealt with our partners' loss if floods had not occurred." In the hierarchical cultural environment, AFSC organisations were also impacted by those in superior roles, such as government leaders: "It was not until the afternoon of the 19th [July] that the main person in charge of the municipal party committee, and the main person in charge of the municipal government on the morning of the 20th, inspected the flood preparation work for the first time since 13 July 2021." Coupled with the fact that the government did not use information technologies effectively to disseminate weather information, AFSCs had little opportunity to prepare for the forthcoming floods because they received limited information: "The three major telecoms operators (China Mobile, Unicom and Telecom) shared the red heavy rain warning throughout the entire network only once on the 19th." The second reason for supply chains' lack of preparedness was that strategic stock is not an option for most agri-food organisations owing to the effects of lean operations and the perishability of food products. [Table 3](#)

summarises empirical evidence demonstrating the limited preparedness of AFSCs in the face of the 2021 Henan floods.

At the organisational level, organisations are identified as lacking preparedness for several reasons. First, contingency plans had not been developed specifically for floods. As one interviewee noted: "We had contingency plans for general disasters, but these plans were not for floods." Henan is located in northern China, a region traditionally perceived as having a low likelihood of flooding. This perception was echoed by another participant: "We have been working in the drought-prone environment of northern China for many years and have lost vigilance against major floods disasters. We did not expect that a flood would occur." This sense of low risks may have been amplified by the hierarchical cultural environment, where leaders paid insufficient attention to flood preparedness. Consequently, many organisations only developed contingency plans for generic disasters rather than those tailored to flood events. This also resulted in low operability in the face of the 2021 Henan floods. Second, channels for acquiring information were limited. Our interviewees mentioned many times that they had received relevant information too late: "We obtained the red heavy rain warning information on 19 July. However, it was too late for us to prepare for the forthcoming floods." Third, organisations lacked a risk management culture, as disaster prevention and mitigation training was not conducted on a regular basis. Even when such activities were carried out, they often took the form of routine meetings rather than practical, hands-on training. The final reason was lack of leadership: "A responsible leader of an organisation should allocate preparation tasks to specified individuals who have capabilities to complete the task, but this had not happened. In most situations, they are satisfied with general deployment and propose some principal requirements."

Finally, at the individual level, our findings show that individuals were underprepared because of a lack of relevant knowledge and skills, lack of awareness of the flooding risk, and empiricism. With regard to knowledge and skills on how to prepare for a flood: "Our organisation organised a lot of trainings that relevant to production and packaging each year, but nonrelevant to floods." Most people were unaware of the risk and underestimated the effects of floods for several reasons. First, individuals relied heavily on prior experience, which fostered a low awareness of flooding risk, particularly given that no major floods had occurred in Henan for many years. As one interviewee observed: "We have not had a flood for many years. No one thought that heavy rain would develop into floods... We always drew on our historical data and experience to prepare for relevant crises." Second, traditional and digital media, including broadcasts, television, newspapers, and new media were not effectively utilised to disseminate flood control and emergency safety knowledge. As a result, the general public did not receive timely information and was unable to prepare adequately. One interviewee highlighted this issue: "The early warning information from the urban management control and water resources departments was only sent to county (city/district) flood control headquarters or relevant

**Table 3.** Empirical evidence of AFSCs' lack of preparedness in the face of 2021 Henan floods.

First-order codes	Second-order themes	Aggregate dimensions
<ul style="list-style-type: none"> <li>• "We did not make preparations for floods till continuous heavy rain."</li> </ul>	Lack of awareness of flooding risk	Individuals lack preparedness
<ul style="list-style-type: none"> <li>• "We never even thought that a flood would occur."</li> <li>• "We did not realize that a flood would occur because there had not been a flood for a long time."</li> <li>• "We have not had a flood here for decades."</li> </ul>	Empiricism	
<ul style="list-style-type: none"> <li>• "When facing a flood, we did not know what to do at first."</li> <li>• "We had not received any training related to floods before."</li> </ul>	Lack of relevant knowledge and skills	
<ul style="list-style-type: none"> <li>• "Our company does have emergency plans for various unexpected incidents, but they are merely formalities and have rarely been practised."</li> </ul>	Lack of contingency plans for floods	Organizations lack preparedness
<ul style="list-style-type: none"> <li>• "The flood happened so suddenly that our company did not have any related emergency plans."</li> <li>• "Our company received the official notice very late, saying that a flood was highly likely to occur."</li> </ul>	Limited information acquisition channels	
<ul style="list-style-type: none"> <li>• "The meteorological department's forecast information is sometimes inaccurate, and most of the time we rely on experience to make decisions."</li> </ul>	Lack of risk management culture	
<ul style="list-style-type: none"> <li>• "As an agricultural production company, there is generally little risk, and the relevant risks have been emphasized."</li> <li>• "The most discussed topic was how to ensure safety in production, not about how to prevent floods."</li> </ul>	Lack of leadership	
<ul style="list-style-type: none"> <li>• "Many things were just formalities, and when it comes to preventing floods, the leadership was also unclear."</li> <li>• "Our leadership was also unclear about how to prevent the incoming floods."</li> </ul>	Lack of strategic stock	Supply chains lack preparedness
<ul style="list-style-type: none"> <li>• "Our company prepared some plastic and cardboard boxes for packaging because they are easy to store."</li> <li>• "By the time we realized that a flood might occur, it was no longer realistic to increase our inventory."</li> </ul>	Lack of information sharing	
<ul style="list-style-type: none"> <li>• "At this stage, we did not share the news about the possible floods with other companies because it was an uncertain issue."</li> <li>• "All of our suppliers are in this area, and we assumed that they might have information about the flood."</li> </ul>		

authorities and was not released to the public in a timely manner." Although government agencies eventually released relevant information on the day of the flood, this occurred too late to enable preparation. Another interviewee criticised the delay: "At 18:58 on the 20th, the government directed its affiliated new media outlets to continuously disseminate local meteorological forecasts, warnings, and rainfall updates. Yet, by that point the flood had already struck, leaving the public with virtually no time to prepare."

Regarding cross-level interactions during the preparation phase, our findings reveal that lack of coordination, lack of trainings, lack of preparation, and lack an approach to identify flood risk play a critical role in shaping interactions between supply chain and organisational levels, as well as between organisational and individual levels (see [Appendix E1](#)). For example, lack of trainings is widespread in the investigated organisations, which we believe critically influences individuals' behaviours in preparing for floods. As one interviewee stated: "The company has long underestimated flood risks and has essentially failed to conduct scenarios drills or disseminate disaster preparedness knowledge, resulting in employees lacking relevant experience and being unsure of the appropriate measures to take in emergencies." Organisations lack an approach to identify flood risk, which we believe may influence supply chain operations. As one interviewee noted: "Most companies in this area lack the capacity to detect flood risks, leading to a failure to identify potential risks to suppliers, logistics, and warehousing in a timely manner."

Based on our findings, we developed a multi-level resilience framework that connects individuals, organisations, supply chains, and environments to illustrate the lack of preparedness during the 2021 Henan floods (see [Figure 4](#)). The linkages between these levels were first synthesised from the collected primary and secondary data and subsequently validated by our interviewees through follow-up email correspondence. In a hierarchical cultural environment where different levels of government authorities possess extensive power to mobilise resources, a lack of risk awareness and bottom-line thinking among key government leaders can cascade throughout the entire society, leading to a widespread lack of preparedness. Several factors contribute to this lack of awareness. First, the empiricism of key government leaders often leads them to rely on past experiences rather than scientific evidence. For example, some leaders assumed that rainfall in Northern China would remain relatively low based on historical patterns, thereby underestimating the potential severity of future flooding events. Second, both government leaders and the general public often lack sufficient knowledge related to disaster preparedness and prevention, and many have no prior experience of severe flooding events, which further contributes to inadequate readiness. Third, although the government holds absolute power to control both traditional and new media platforms, these channels were not effectively utilised to disseminate flood preparedness information. Finally, the hierarchical cultural environment further amplifies the empiricism and

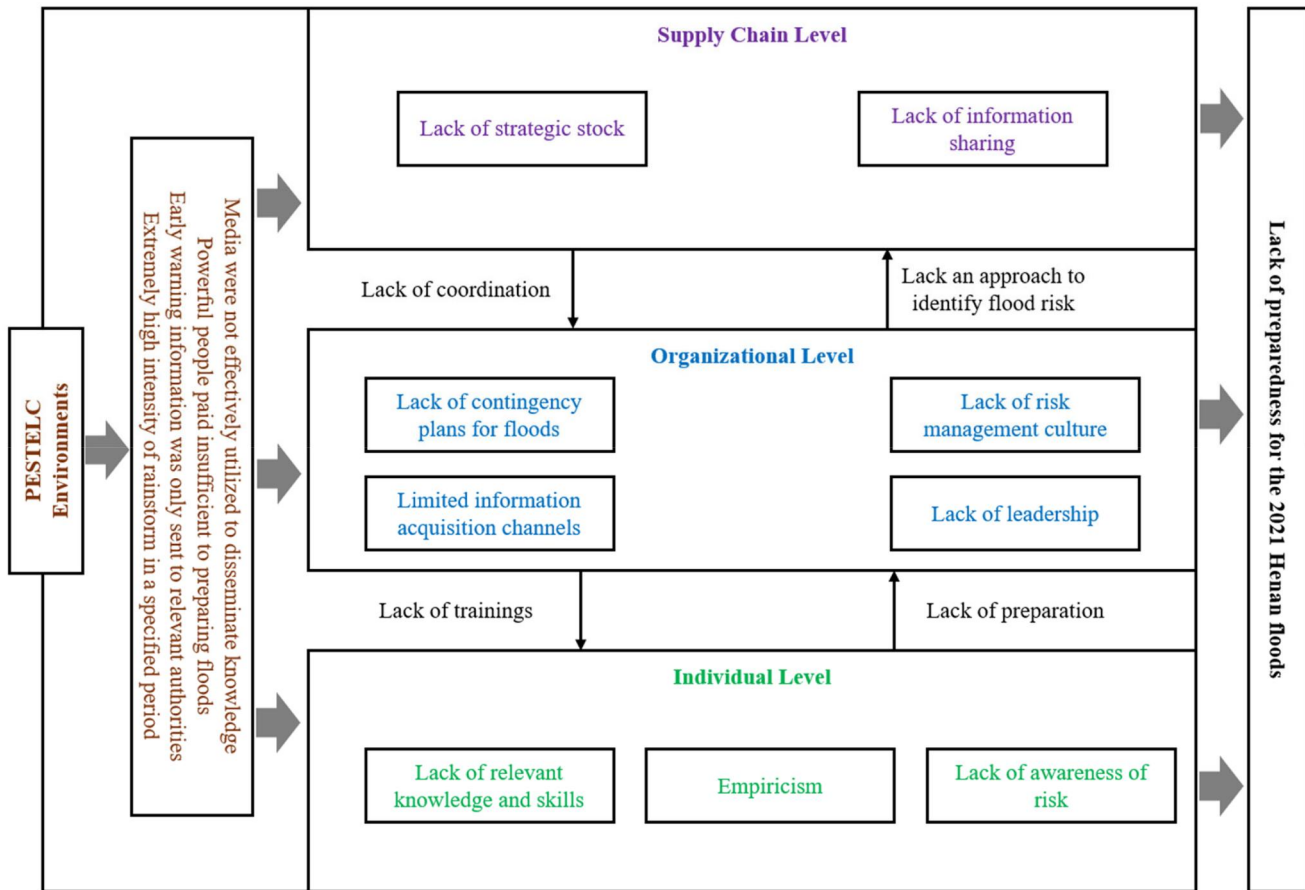


Figure 4. Lack of preparedness for the 2021 Henan floods.

limited disaster knowledge of key government leaders, resulting in a widespread lack of preparedness across society. Drawing on the focal points of our discussions, we propose the following:

**Proposition 1.** *In a hierarchical cultural context, leaders' limited disaster management knowledge can cascade through supply chains, organisations, and individuals, leading to a systemic under-preparedness for flood events.*

#### 4.2. Response phase: instant and effective response

When individuals and organisations realised that the flood was coming, they began to adopt various response measures. First, from the natural environmental perspective, in the face of rapidly changing weather conditions, the meteorological department increased the frequency of its weather forecasts from every eight hours to every two hours, ensuring that individuals and organisations could receive timely weather information to support their decision-making. Weather information was especially important in enabling individuals and organisations to determine when to take response measures: "The most suitable time point to start emergency aid was when it was not raining or when the rain was light, otherwise it would cause additional losses." Meanwhile, new media platforms (e.g. WeChat channel and live, Weibo, Kuaishou, Douyin, and Toutiao) were used effectively to implement 24-hour, non-stop broadcasts to share

weather forecasts, rain conditions, and other disaster relief information. In particular, positive disaster relief stories, such as donations from enterprises and Blue Sky Rescue Team's timely support, were widely disseminated through these digital platforms to secure empathy from individuals, and thus help to establish positive public opinion. Second, a stable political and economic environment was also important in enabling resources to be provided to support organisations' and supply chains' responses. For example, a stable political environment is a prerequisite for successful disaster governance, as poorly governed societies and weak governments exhibit deficiencies in disaster governance (Tierney 2012). A stable economic environment can provide sustainable financial resources to support the responses of individuals, organisations, and supply chains. For example, on 21 July, ¥60 million were allocated from the central government natural disaster relief fund to support emergency rescue and relief work. Finally, from the legal environmental perspective, the local government issued an emergency notice enabling enterprises, institutions, and agencies not involved in city operations to adopt flexible working. The emergency notice was subsequently amended to prevent gatherings and suspend classes and businesses owing to the constant heavy rain. Meanwhile, the provincial government initiated a Level 1 flood control emergency response (highest level). This meant that competent authorities in different industries, including agriculture, had to extensively mobilise resources, coordinate the forces of all parties, and make every effort to

provide rescue, disaster relief, and emergency support (Henan Provincial Department of Emergency Management 2024). However, simply having the appropriate policies and regulations in place was insufficient to ensure that individuals and organisations did their best. The Commission for Discipline Inspection subsequently issued accountability regulations relating to floods, holding accountable those late- or under-reporting flood-relevant information. For example, one interviewee stated: “At our enterprise, Party-member leading cadres are required to take the lead on flood duty and stand on the front lines. Failure to do so results in disciplinary action.” Another interviewee provided a more detailed example: “Disciplinary officials conduct on-site inspections to ensure flood defences are in place. Any failure to meet standards results in immediate sanctions, including a two-year freeze on all promotion opportunities.” In a hierarchical cultural environment, accountability mechanisms provide some guarantee that individuals and organisations will work together to achieve synergies and deter opportunistic behaviours. Thus, we propose the following:

**Proposition 2.** *In a hierarchical cultural context, accountability mechanisms facilitate coordination across individuals, organisations, and supply chains, thereby enabling timely and effective responses to flood disruptions.*

Meanwhile, organisations adopted various strategies to respond to the floods, most of which related to flexibility (see Table 4). For example, flexible and remote working allowed employees to work at home and managers to make flexible decisions: “A lot of decisions had to be made in a very short period of time, such as checking damage to personnel and equipment.” Top management teams’ supports was also critical in enhancing organisational cohesion, such as top management team members living and eating together with frontline workers and making instant decisions about different situations. In the hierarchical cultural environment, this support was critical in enabling timely responses because people followed their leaders’ decisions to implement tasks. One interviewee stated: “The government arranged agricultural and technical experts to help us deal with flooded farms.” Finally, our interview data reveal that organisations adopted strategies such as rewards and penalties and intra-organisational information sharing to respond to the floods. WeChat groups were built to enable timely information sharing.

At the supply chain level, our findings show that three strategies were implemented to improve the response: inter-organisational information sharing, postponement, and government support. Organisations sought to share inventory information (e.g. packaging materials, agrichemicals, and agricultural equipment) with their suppliers to identify any opportunities to obtain raw materials sooner. They also shared flood information and expected dates of reshipping with their buyers to secure empathy for shipping delays. Buyers were free to cancel their orders without penalties if they could not accept the reshipping dates. Government support also played an important role in helping the supply chain response, such as allocating free high-pressure water

pumps, relocating, and providing temporary accommodation for workers trapped by floods, and providing point-by-point guidance on implementing response strategies. Thus, we propose the following:

**Proposition 3.** *Effective flood response depends not only on organisational and SCRes strategies but also on sustained resources and support from the broader PESTELC environment.*

Organisational and SCRes strategies had to be implemented by appropriate individuals. Our findings reveal six personal traits conducive to implementing various response strategies. In the face of the floods, even though rewards and penalties were established, some employees were still unwillingness to enact the response strategies owing to the dangers associated with implementing them during the emergency response phase. One interviewee stated: “In the emergency response phase, associated disasters such as houses collapsing and roads being damaged frequently happened. This caused challenges to work at the company.” Thus, ambitious and courageous employees keen to be promoted were used to implement the strategies. For example, some organisations used people who were in a public notification period prior to promotion to implement relatively dangerous tasks. Moreover, working overtime and even double shifts required energetic employees. One interviewee stated: “During the flooding event, we require constant 24-hour shifts and rapid emergency response. Brave, action-oriented young personnel are our primary choice for these roles due to their readiness to execute orders.” Finally, conscientious people were needed to ensure full implementation of response strategies and leaders’ intentions. Thus, we propose the following:

**Proposition 4.** *Organisational and SCRes strategies translate into effective flood responses when implemented by individuals with appropriate personal traits.*

Regarding cross-level interactions during the response phase, our findings indicate that several mechanisms are adopted to shape interactions between supply chain and organisational levels, as well as between organisational and individual levels (see Appendix E2). For example, supply chain stakeholders demonstrated empathy and collectivism towards affected companies by adjusting transportation routes and prioritising deliveries to the impacted areas. As one interviewee stated: “For affected companies, our company will promptly adjust freight routes and extend their payment deadlines.” Organisations demonstrate honesty towards other supply chain stakeholders: “To avoid negatively impacting upstream and downstream supply chain partners, our company provides timely reporting of its damage status and recovery capability.” Moreover, our findings show that interactions between organisational and individual levels are shaped by selecting appropriate individuals to undertake relevant tasks, as working during floods is characterised by high stress, high uncertainty, rapid decision-making requirements, and emotional pressure.

Figure 5 illustrates how individuals, organisations, supply chains, and environments collectively responded to the

**Table 4.** Organisational resilience strategies, SCRes strategies, and personal traits relevant for responding to floods.

First-order codes	Second-order themes	Aggregate dimensions	Level
<ul style="list-style-type: none"> <li>• "Our employees could work at home to avoid additional losses."</li> <li>• "During heavy rainfall, our employees are permitted to stay home until the rain subsides to a lighter level."</li> <li>• "In the face of floods, a lot of decisions must be made in one or two days."</li> <li>• "We work tirelessly every day during flooding to make prompt decisions."</li> <li>• "A lot of things should be replanned, such as raw material delivery ..."</li> <li>• "After the flood came, everything fell into chaos, and we needed to reorganize many things."</li> <li>• "For employees with excellent performance, we would promote them and have cash awards."</li> <li>• "We imposed penalties on employees who failed to take action in the face of the flood."</li> <li>• "Top management team members, department managers, and even group leaders were required to work with ground-level employees to ensure smooth operations of our company."</li> <li>• "Key leadership personnel must be on duty 24 hours a day."</li> <li>• "We shared knowledge across different departments of our company, such as flood prevention."</li> <li>• "We quickly created a cross-department WeChat group for real-time communication."</li> <li>• "We shared information with our suppliers and buyers."</li> <li>• "Our company quickly and promptly shared our latest situation with our upstream and downstream suppliers."</li> <li>• "Governments provided us with emergency assistance by providing knowledge sharing sessions."</li> <li>• "The government provided a large amount of rescue equipment"</li> <li>• "Due to lack of packing materials, we shared information with our buyers and postponed delivery."</li> <li>• "We will extend the delivery deadlines for the flooded enterprises."</li> <li>• "Only courageous individuals would risk their lives in the pouring rain to participate in the rescue operation."</li> <li>• "Despite the incentives we offered, only a few people were willing to remain on duty at the factory when confronted with the secondary risk of the flood."</li> <li>• "Since we operated a 24-hour duty system, it was the energetic young people who were best suited."</li> <li>• "A power outage in the cold storage in the middle of the night, which required immediate overnight repairs."</li> <li>• "We had to handle emergencies at any time to avoid causing further damage."</li> <li>• "Those who can quickly adapt to these changes and address the related challenges will be critical."</li> <li>• "Only those with a strong desire for promotion would participate in rescue efforts and similar activities."</li> <li>• "In the face of the flood, we gave priority to Party members in participating in the response efforts."</li> <li>• "Our marketing managers is outgoing, excellence at communication, and skilled in handling interpersonal relationships effectively."</li> <li>• "Extroverted individuals are more suited to establishing connections with the government."</li> <li>• "Managers usually value individuals who approach their work with diligence and precision."</li> <li>• "Individuals who lack attention to detail tend to be less effective in their roles."</li> </ul>	<ul style="list-style-type: none"> <li>Flexible and remote working</li> <li>Flexible decision making</li> <li>Flexible planning</li> <li>Reward and penalties</li> <li>Top management team's support</li> <li>Intra-organizational information sharing</li> <li>Inter-organizational information sharing</li> <li>Emergency government assistance</li> <li>Postpone strategy</li> <li>Courageous</li> <li>Energetic</li> <li>Flexible</li> <li>Ambitious</li> <li>Extravert</li> <li>Conscientious</li> </ul>	<ul style="list-style-type: none"> <li>Flexibility</li> <li>Leadership</li> <li>KM</li> <li>KM</li> <li>Supply chain collaboration</li> <li>Personal traits</li> </ul>	<ul style="list-style-type: none"> <li>Organizational</li> <li>Supply chain</li> <li>Individual</li> </ul>

floods. PESTELC environments were responsible for providing resources (e.g. financial, human, technological and policy resources) to support the responses of organisations and supply chains. In particular, the hierarchical cultural and legal environments provide certain guarantees that individuals, organisations, and supply chains would achieve synergies. Our findings also indicate that organisational and SCRes

strategies had to be carried out by individuals with appropriate personal traits.

#### 4.3. Recovery phase: long and complex process

The 2021 Henan floods were swift and intense, with a high velocity and volume of water owing to heavy rainfall and

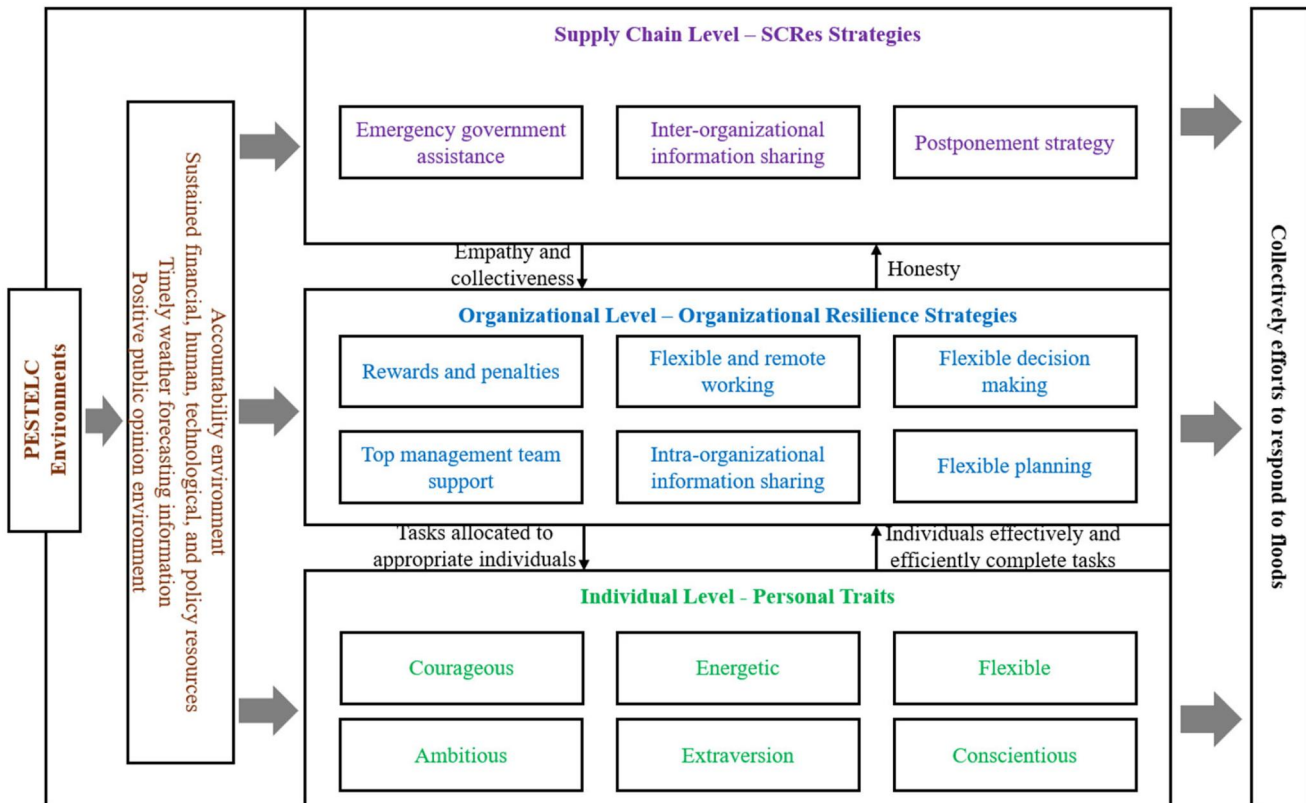


Figure 5. A multi-level SCRes framework: response to floods.

poor drainage systems. Individuals, organisations, and AFSCs determined when to implement recovery based on hydrological and meteorological departments' guidance: "If it is foreseeable that the centre of heavy rain will move and gradually weaken, then we can develop and implement recovery strategies." When individuals and organisations realised that it was time to implement recovery strategies, various technologies were used, such as using drones to check flooded fields, high-pressure water pumps to pump out water, and equipment to generate electricity. One interviewee stated: "We were allocated several high-pressure water pumps for pumping water because we are big producers." Moreover, agricultural expert service groups were arranged to visit flooded areas and guide post-disaster recovery. However, only big producers received face-to-face expert guidance. Stable political and economic environments also played an important role in supporting recovery because huge long-term investments were required. For example, ¥40 million were allocated from central government's agricultural production disaster relief fund to support post-disaster agricultural production recovery. The Henan provincial government developed compensation standards for flooded farmers: "Simplified compensation processes were very important for us to obtain money from governments. For example, we got our compensation in ten days." This compensation helped farmers to buy new agricultural machinery and supported emergency re-planting. However, it might still be difficult for agri-food enterprises to recover after experiencing a flood, so continued financial and policy support following the floods

was critical. For example, a post-disaster recovery and reconstruction plan (2021–2024) was developed to support the revitalisation of various industries, including agriculture. In particular, priority was given to financial support to reconstruct key agricultural infrastructure, such as high-quality farmland, agricultural wholesale distribution markets, and rural logistics networks. In this process, the hierarchical cultural environment played a critical role in helping organisations and supply chains to recover. This was due to the "chain leader system", which refers to government leaders taking charge as chain leaders, as they have extensive capabilities to gather internal and external resources to enhance modernisation and support high-quality development of a region's industrial chain. For example, the provincial leader was responsible for AFSCs' recovery because flooded agribusinesses were located across the region and massive coordination activities were required. County leaders had a duty to ensure the recovery and adaptation of agribusinesses located within their areas of responsibility, and agribusinesses leaders were responsible for the operations of their own companies. One interviewee stated: "Through the coordination of our leadership, we have secured a dedicated production recovery fund. This capital is absolutely critical for the swift reconstruction of our production lines." Another interviewee highlighted: "At our insistent request, the government dispatched a team of on-site agricultural experts. This has played a pivotal role in the rapid restoration of our vegetable production." In the recovery phase, significant resources had to be fairly allocated across organisations and individuals, so

**Table 5.** Organisational resilience strategies, SCRes strategies, and personal traits relevant to recovery from floods.

First-order codes	Second-order themes	Aggregate dimensions	Level
<ul style="list-style-type: none"> <li>• "We had trucks that could be used in flooded areas because our logistic partners had a green pass."</li> <li>• "We needed to reorganize our routes to avoid flood-affected areas."</li> </ul>	Flexible transportation	Flexibility	Organizational
<ul style="list-style-type: none"> <li>• "Employees' houses were flooded and resulted in them not having enthusiasm to work. Thus, we invited psychologists to deliver online psychological consulting."</li> <li>• "Our company offers free online psychological counselling services."</li> </ul>	Psychological counselling service	Assets and resourcefulness	
<ul style="list-style-type: none"> <li>• "Our farms were flooded; we needed to access to financial resources to support our recovery."</li> <li>• "We can apply for small, interest-free loans."</li> </ul>	Bank credit and financial resources		
<ul style="list-style-type: none"> <li>• "We developed strong leadership to ensure recovery strategies could be continuously delivered."</li> <li>• "In the face of the flood, leadership personnel must take the lead and be at the forefront."</li> </ul>	Strong leadership	Leadership	
<ul style="list-style-type: none"> <li>• "We shared information with our suppliers and buyers."</li> <li>• "Our company promptly shared our latest situation with our upstream and downstream suppliers."</li> </ul>	Inter-organizational information sharing	KM	Supply Chain
<ul style="list-style-type: none"> <li>• "Suppliers from other provinces should be considered and more customers from other provinces could be developed."</li> </ul>	Diversify of suppliers and customers	Supplier management	
<ul style="list-style-type: none"> <li>• "We must ensure diverse supply channels."</li> <li>• "We shared our green-pass trucks with other flooded enterprises to ensure on-time delivery."</li> <li>• "For businesses affected by floods, we will extend their delivery deadlines and may even provide financial assistance."</li> </ul>	Sharing resources to strengthen collaboration	Supply chain collaboration	
<ul style="list-style-type: none"> <li>• "Local and national governments developed a long-term plan to support flooded organizations."</li> <li>• "The government provides long-term support to businesses affected by the flood, such as interest-free loans."</li> </ul>	Long-term government support		
<ul style="list-style-type: none"> <li>• "Our colleagues in the external relations department are generally proactive and sociable."</li> <li>• "Extroverted individuals are more likely to form extensive social networks and are willing to maintain a larger number of social connections."</li> </ul>	Extraversion	Personal traits	Individual
<ul style="list-style-type: none"> <li>• "Employees with high openness can adapt more quickly to such adjustments and help drive the recovery process."</li> <li>• "Employees with high openness are more willing to learn new knowledge, thereby accelerating the company's recovery."</li> </ul>	Openness		
<ul style="list-style-type: none"> <li>• "If employees are reliable, management can focus more on decision-making and resource allocation, rather than frequently monitoring or supervising employee performance."</li> </ul>	Reliability		
<ul style="list-style-type: none"> <li>• "Reliable employees consistently fulfil their responsibilities, which enhances team trust."</li> <li>• "If employees feel a sense of loyalty toward the company, they are more likely to stay, willing to confront challenges together, and help reduce secondary losses caused by talent attrition."</li> <li>• "Loyalty employees can help maintain team cohesion, rebuild trust and a sense of security, and thereby accelerate the return to normal business operations."</li> </ul>	Loyalty		

the involvement of Discipline Inspection Commission was critical for accountability and creating positive public opinion. Thus, we propose the following:

**Proposition 5.** *In a hierarchical cultural context, the ability of government leaders to mobilise internal and external resources enables effective recovery of supply chain and organisational operations following floods.*

Four SCRes strategies were adopted to help AFSCs to recover from the floods: inter-organisational information sharing, long-term government support, diversification of customers and suppliers, and resource sharing to strengthen

collaboration. Table 5 presents the organisational resilience strategies, SCRes strategies, and personal traits that are relevant to the recovery phase following floods. For example, less affected agribusinesses were willing to share resources with those most affected: "In the face of floods, we are happy to share resources with our supply chain partners, such as shared warehouses and shared transportation trucks." Trucks with green passes issued by the local government were able to collect and deliver agri-food products to flooded areas. Agribusinesses also tried to diversify their suppliers and customers, as most of their suppliers were concentrated in Henan, the major grain-producing area: "We are

trying to find suppliers from other provinces that can provide us with materials (e.g. plastic packaging, agrichemicals and cardboard) in a short time.” In the chain leader system, the provincial leader acted as the chain leader responsible for AFSCs’ recovery and adaptation, which enabled events such as “thousands of people to help thousands of enterprises” to be implemented to help agribusinesses’ recovery. This event aimed to solve the development difficulties and problems encountered by enterprises and promote their transformation through joint efforts by the government, enterprises, and all sectors of society. To achieve synergies between agribusinesses, two aims relating to recovery and adaptation were proposed: restoration and improvement of food security capabilities, and recovery of agricultural and animal husbandry production (National Development and Reform Commission 2022). Some evidence suggests that the agricultural system recovered from the floods. For example, Henan’s grain output in 2020 was 136.5 billion kilograms, which dropped to 130.884 billion kilograms in 2021 owing to the floods, but then climbed to 136 billion kilograms in 2022 (Henan Provincial Development and Reform Commission 2024).

When AFSCs set recovery goals, organisations soon developed strategies to contribute to the process. Our findings show that four strategies were used to support agribusinesses’ recovery: flexible transportation, psychological consulting services, bank credit and financial resources, and strong leadership. For example, organisations began to find logistics companies with green passes enabling them to access flooded areas to load and deliver products. This was because it took time for the floods to recede. Strong leadership was also required, especially in the face of the huge losses caused by the floods: “Honestly, in the face of destroyed greenhouses and huge losses caused by the floods, I do not know whether our company can recover from it.” Psychological consulting services were important to ensure that employees could work normally. Thus, online and in-person psychological consulting services were arranged: “Providing psychological counselling can help employees rebuild their sense of security, restore trust and a positive mindset, and enable them to return to work more quickly, thereby accelerating the company’s recovery and resumption of production.”

AFSCs and agribusinesses developed resilience strategies to recover from the floods, but these strategies’ successful implementation relied on appropriate individuals. At this stage, the most important tasks for agribusinesses were to obtain resources (e.g. finance, equipment, free training, expert guidance) to support their recovery. This was particularly important for them because many agribusinesses in this area were flooded. Therefore, organisations were encouraged to build relationships with key individuals in government to obtain more resources for recovery. One government officer highlighted: “Which enterprise should be helped first, and which one should be helped later? The results are completely different.” Therefore, employees good at developing *guanxi* with government members to establish complex networks of assistance were considered a critical advantage. Our

findings show that employees with the attribute of openness and extraversion were suited to implementing strategies involving extensive personal connections/relationships, such as long-term government support, bank credit and financial resources, and sharing resources to strengthen collaboration. Thus, we propose the following:

**Proposition 6.** *In a networking-oriented socio-cultural context, individuals with high openness and extraversion are more likely to develop external support networks that enable organisations to recover from flood disruptions.*

Regarding cross-level interactions during the recovery phase, our findings indicate that several mechanisms are adopted, including setting recovery goals to support development, coordinating to achieve synergies, allocation tasks to appropriate individuals, and acquiring additional resources to complete tasks (see Appendix E3). During the recovery phase, individuals may require additional resources to complete relevant tasks as task pressure increases due to the need to compensate for lost production, resume order fulfilment, and meet delivery deadlines. This is particularly critical at this stage, when resources are still being reconfigured. Organisations need to coordinate with upstream and downstream stakeholders to ensure access to raw materials and customer orders.

Based on our findings, we developed a multi-level SCRes framework (see Figure 6) to understand how individuals, organisations, supply chains, and PESTELC environments collectively recovered from the floods.

#### 4.4. Adaptation for future: learning and improvements

The adaptation phase in SCRes refers to the post-disruption stage during which supply chain stakeholders reflect on lessons learned from the crisis, adjust their strategies accordingly, and implement improvements to enhance resilience against future disruptions (Nibbrig, Azadeh, and Maknoon 2025). At this stage, scholars have identified two key strategies. Adaptive resilience (AR) strategies focus on rapid recovery and are primarily relevant to short-term operational recovery, whereas transformative resilience (TR) strategies emphasise long-term structural adaptation and are closely linked to sustainability and innovation (Abudu et al. 2025). For example, Küffner et al. (2022b) proposed several strategies for both AR/TR. AR strategies include establishing alternative suppliers, implementing a multiple sourcing strategy, and executing a proactive supply chain risk management, whereas TR strategies encompass sustaining supply chain transparency, maintaining cross-company data management, and using supplier platforms to digitalise collaboration.

After synthesising the empirical data collected in China, we identified several adaptation pathways for organisations and AFSCs (see Figure 7). We categorised these adaptation goals following on the framework proposed by Abudu et al. (2025) work, as shown in Table 6. For the disrupted agri-food organisations, four key adaptation goals are identified: deploying and practising contingency plans, strengthening employee loyalty, securing backup power for storage

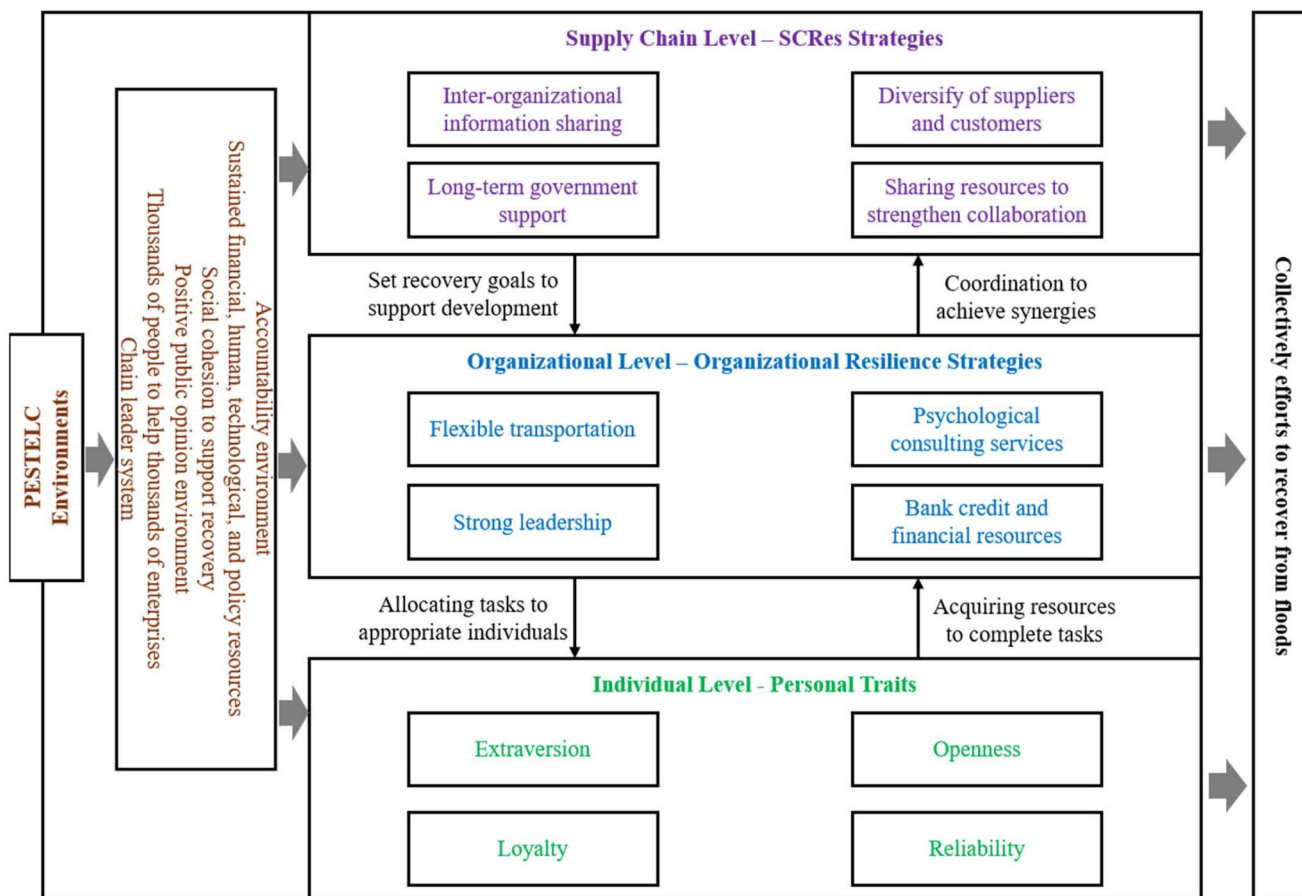


Figure 6. A multi-level SCRes framework: recovery from floods.

facilities, and purchasing flood insurance. In China, the government has approved pilot projects to expand the scope of catastrophe insurance beyond earthquakes to include other types of disasters, such as floods and typhoons (Qu 2024). As for the adaptation goals for AFSCs, we identified four key priorities: establishing backup suppliers, conducting coordinated emergency training across supply chain level, advancing the digitalisation of AFSCs, and more flexible, cohesive, collaborative, and practical (FCCP). For example, our AFSC practitioners highlighted several advantages of digitalising AFSCs rather than individual organisations, including enhanced resilience through rapid execution of alternative supply and logistics options, improved coordination to enable collaborative recovery and reduce overall losses, and the ability to share information across the entire supply chain, allowing for faster alerts. Adaptation goals should be implemented by individuals possessing appropriate personal traits, such as extraversion, reliability, conscientiousness, loyalty, curiosity, and persistence. As for cross-level interactions during the adaptation phase, our findings indicate that the mechanisms are not substantially different from those employed during the response phase (see Appendix E4).

## 5. Discussion

The topic of SCRes has attracted significant scholarly attention, particularly in the context of heightened business uncertainty and the increasing frequency and severity of

natural disasters (Zeiser et al. 2025). Drawing on insights from 54 semi-structured interviews with AFSC stakeholders, complemented by an analysis of archival data, this study develops a novel understanding of SCRes. Specifically, we conceptualise SCRes as a multi-level framework that encompasses individuals, organisations, supply chains, and the broader environment. We argue that resilience emerges through the collective efforts of these actors across the phases of preparation, response, recovery, and adaptation. By advancing this multi-level perspective, our study addresses critical gaps in the existing literature and offers actionable implications for both researchers and practitioners seeking to strengthen resilience within organisations and across supply chains. Figure 8 illustrates the multi-level SCRes framework emerging from this study. This framework was developed inductively from our empirical findings and subsequently validated through expert review. China's socio-cultural environment is characterised by hierarchy, with strong emphasis on fulfilling one's obligations within a hierarchical system. This structure means that governments at different levels possess discretionary authority to allocate resources during crises. This socio-cultural environment aligns with the chain leader system, in which supply chain development is guided by the government, with leading enterprises acting as backbone and coordinating upstream and downstream collaboration. Therefore, leading enterprises of AFSCs can set recovery and adaption goals under government guidance. These goals can then be disseminated to

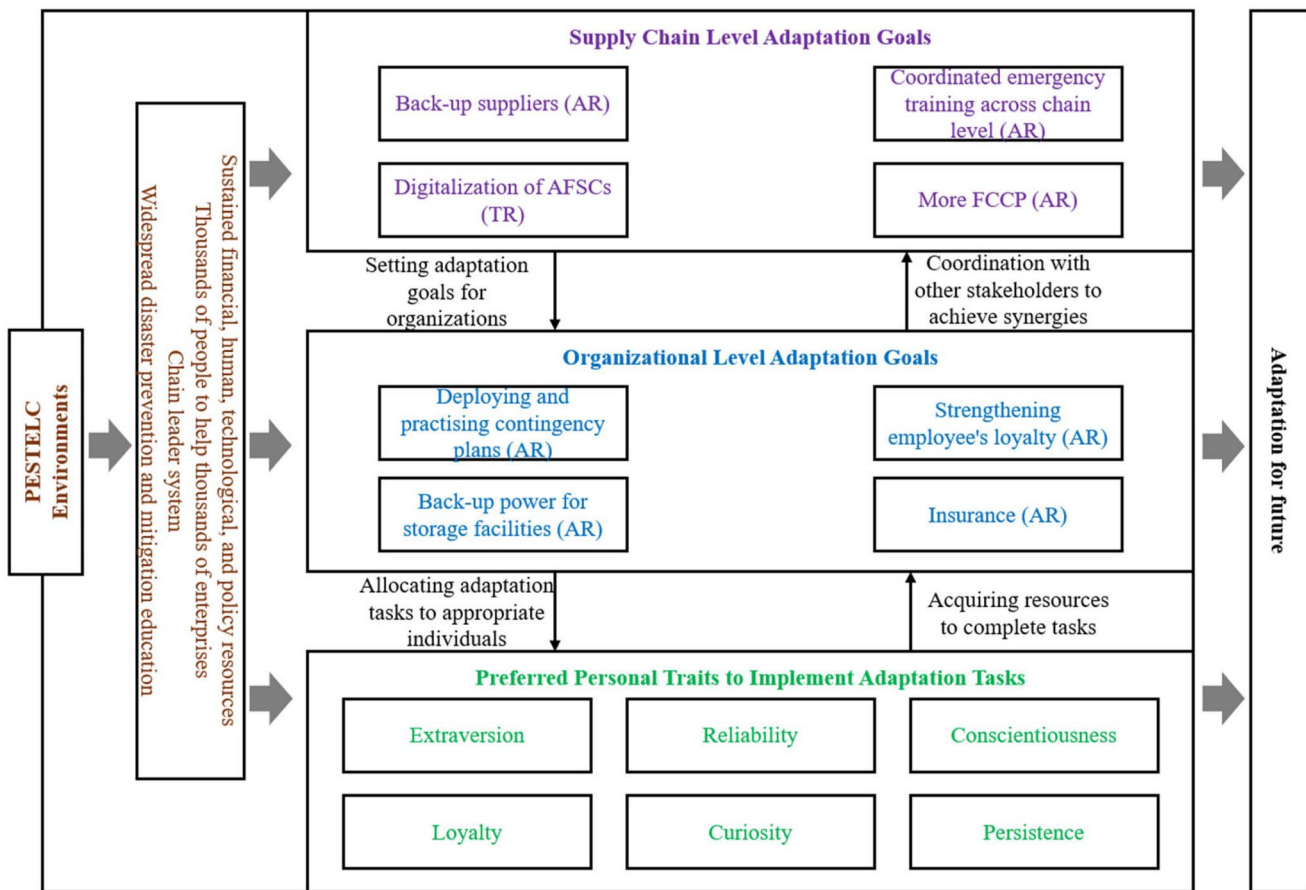


Figure 7. A multi-level SCRes framework: adaptation for future (note: AR represents adaptive resilience, TR represents transformative resilience).

different organisations within the supply chain and, subsequently to individuals within those organisations. From this perspective, the hierarchical socio-cultural environment acts as a “lubricant” that connects supply chain, organisational, and individual levels, ensuring coordinated actions and collective efforts to achieve synergies across the four SCRes phases. Moreover, to prepare for, respond to, recover from, and adapt to floods, particularly in an era where climate change induced extreme weather events are becoming more frequent, sustained investment in building SCRes is essential. This requires a stable political and economic environment that can provide continuous financial resources, a supportive legal environment that offers policy backing, and a technological environment that supplies digital infrastructure and innovation. Collectively, these political, economic, legal, and technological environments can be viewed as the “soil” for fostering SCRes by enabling the provision of sustained financial, policy, and technological support.

### 5.1. Theoretical contributions

Several scholars have discussed what constitutes a theoretical contribution. For example, Whetten (1989) suggested that a study contributes theoretically by explicitly articulating what, how, and when. Corley and Gioia (2011) further argued that theoretical contributions lie in providing original insights into a phenomenon by advancing knowledge in ways that are useful or meaningful for some purposes. More recently,

Rouse et al. (2025) focusing specifically on qualitative research, emphasised that theoretical contributions often arise when researchers uncover contradictions, dialectics, paradoxes, or unexpected relationships that challenge established frameworks and stimulate new ways of thinking about a phenomenon. Our research aligns with these perspectives by proposing that: (1) SCRes can be conceptualised as a multi-level framework (*what*), (2) the successful development of SCRes depends on the collective efforts of individuals, organisations, supply chains, and the broader environments, with each level playing distinct roles (*how*), and (3) the effective implementation of SCRes strategies relies on individuals who possess appropriate personal traits (*when*).

Our study’s first contribution extends prior studies (e.g. Adobor 2019; Adobor and McMullen 2018; Novak, Wu, and Dooley 2021; Pettit, Croxton, and Fiksel 2019; Tsvetkova and Gammelgaard 2025; Wieland and Durach 2021) by advancing the notion of SCRes as a multi-level framework that incorporates not only the individual, organisational, supply chain levels, but also the broader environmental level. By identifying various organisational and SCRes strategies, along with the personal traits that facilitate their adoption, we extend what Makadok, Burton, and Barney (2018) describe as *what* should be theorised about and offer insights into the relevant factors that warrant consideration when investigating a phenomenon.

Our study’s second contribution highlights the distinct roles of the individual, organisational, supply chain, and

**Table 6.** Adaptation goals for organisations and AFSCs, and the associated personal traits.

First-order codes	Second-order themes	Aggregate dimensions	Level
<ul style="list-style-type: none"> <li>• "Under the guidance of governments, we regularly practised our contingency plans."</li> <li>• "We now conduct regular water-based emergency drills every year."</li> </ul>	Coordinated emergency training across chain level <sup>(AR)</sup>	Supply chain collaboration	Supply chain
<ul style="list-style-type: none"> <li>• "For future improvement purposes, we preferred to develop an automated supply chain."</li> <li>• "We will deploy some advanced sensors to help us to monitor the weather conditions."</li> </ul>	Digitalization of AFSCs <sup>(TR)</sup>	Innovation	
<ul style="list-style-type: none"> <li>• "We did not have back-up suppliers because of extra costs."</li> <li>• "We have back-up suppliers in this region, but most of them have also been affected by the flood."</li> </ul>	Back-up suppliers <sup>(AR)</sup>	Redundancy	
<ul style="list-style-type: none"> <li>• "In the face of future similar events, we should be more flexible, cohesive, collaborative and practical."</li> <li>• "In the face of the flood, we must strengthen our collaboration with upstream and downstream suppliers."</li> </ul>	More FCCP <sup>(AR)</sup>	FCCP	
<ul style="list-style-type: none"> <li>• "... Some employees wanted to find a new one because there was no hope of recovery."</li> <li>• "We require employees to stand with the company through this challenging time."</li> </ul>	Strengthening employee's loyalty <sup>(AR)</sup>	Leadership	Organizational
<ul style="list-style-type: none"> <li>• "We provided insurance for our employees, but we did not buy insurance for our company."</li> <li>• "Floods are rare for us, which is why we have not purchased related insurance."</li> </ul>	Insurance <sup>(AR)</sup>	Risk management culture	
<ul style="list-style-type: none"> <li>• "Our employees did not know how to tackle floods because they had not encountered this kind of issue."</li> <li>• "We have contingency plans in place, but we do not have a specific contingency plan for floods."</li> </ul>	Deploying and practising contingency plans <sup>(AR)</sup>		
<ul style="list-style-type: none"> <li>• "Back-up power is very important for us because we are agri-food companies."</li> <li>• "We have back-up power systems in place to prevent power outages in the cold storage."</li> </ul>	Back-up power for storage facilities <sup>(AR)</sup>	Assets and resourcefulness	
<ul style="list-style-type: none"> <li>• "Extroverted individuals bridge for information communication, facilitating allocation of resources."</li> <li>• "They communicate more effectively in multi-stakeholder settings, are able to resolve potential conflicts."</li> </ul>	Extraversion	Personal traits	Individual
<ul style="list-style-type: none"> <li>• "Reliable individuals can consistently take on tasks, ensuring adaptive measures continue without interruption."</li> <li>• "Reliable individuals can consistently document experiences and implement improvement measures."</li> </ul>	Reliability		
<ul style="list-style-type: none"> <li>• "People with strong conscientiousness tend to record experiences, summarize lessons, and promote organizational enhancements, support adaptation to future disasters."</li> <li>• "Highly conscientious individuals can usually complete tasks independently without frequent supervision."</li> </ul>	Conscientiousness		
<ul style="list-style-type: none"> <li>• "They have strong sense of belonging and commitment to the organization or team."</li> <li>• "... pay attention to current responsibilities while keeping the organization's long-term goals in mind."</li> </ul>	Loyalty		
<ul style="list-style-type: none"> <li>• "They are willing to proactively study and understand new technologies ..."</li> <li>• "They are able to integrate external experience, technologies, or resources into adaptation phase."</li> </ul>	Curiosity		
<ul style="list-style-type: none"> <li>• "Even when encountering challenges, they can maintain the momentum of recovery actions."</li> <li>• "Their perseverance can motivate team members to stay driven under pressure."</li> </ul>	Persistence		

**Note:** <sup>AR</sup> represents adaptive resilience, <sup>TR</sup> represents transformative resilience.

environmental levels in contributing to SCRes. In the face of high-impact, low-probability events such as floods, successful recovery and adaptation truly rely on the collective efforts across these levels. Since this takes a relatively long time and requires large investments, the PELT environments are an essential resource layer providing continued financial, policy, and technological resources to individuals, organisations, and supply chains. The natural environment acts as a trigger to determine when to implement response and recovery

strategies. Social and cultural environments can be considered "lubricants" connecting individuals, organisations, and supply chains to achieve synergies. In China's socio-cultural environment, with a strong hierarchy and a chain leader system, the supply chain level is the direction layer, setting preparation, response, recovery, and adaptation goals. The organisational level is the transmission layer responsible for disseminating SCRes goals horizontally and vertically. Finally, the individual level is the implementation layer responsible

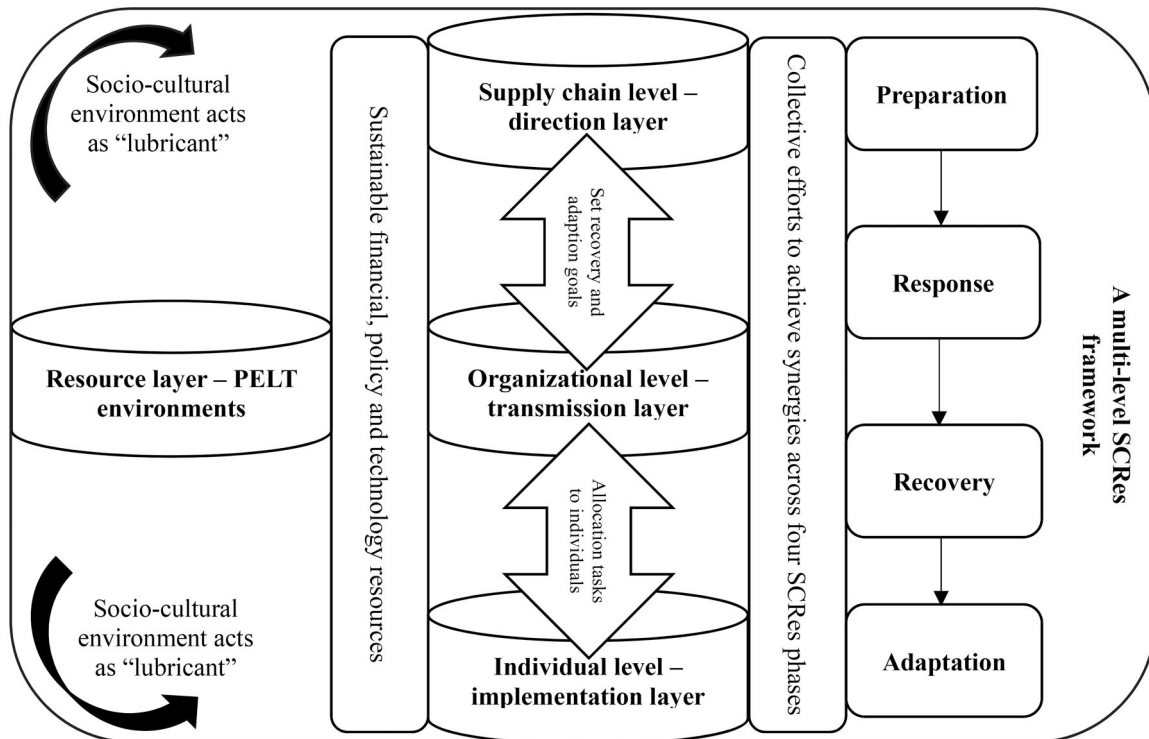


Figure 8. A multi-level SCRes framework.

for implementing organisational and SCRes strategies. Prior studies such as Pettit, Croxton, and Fiksel (2019) emphasised SCRes as a dynamic system shaped by the interdependencies among economic, social, and environmental dimensions, yet they overlooked the critical role of individual actors in fostering resilience. Other studies, including Adobor and McMullen (2018), Novak, Wu, and Dooley (2021), and Wieland and Durach (2021), have sought to examine SCRes from a systemic perspective; however, their predominantly conceptual focus limits scholars' ability to gain deeper empirical insights. Wieland et al. (2023) further emphasise that the interdependencies and interconnectedness inherent SCRes must be explicitly accounted for in research. Our findings indicate that the achievement of SCRes is shaped by the individual, organisational, supply chain, and environmental levels, with each level playing a distinct role. Building on these insights, we aim to illuminate the cross-level mechanisms that underpin SCRes development, therefore beginning to address the how highlighted by Makadok, Burton, and Barney (2018).

Our study's third contribution is the proposition that organisational and SCRes strategies can only be effectively implemented by individuals who possess appropriate personal traits, a dimension that has rarely been examined by prior studies. This is particularly critical in enabling organisations and supply chains to respond to and recover from disruptions efficiently. Our findings identify 11 key personal traits such as courage, energy, openness, reliability, and loyalty that support the implementation of organisational and SCRes strategies across the response, recovery, and adaptation phases. Few prior studies have explicitly linked personal traits to resilience strategies. For example, Oshio et al. (2018) identified five personality traits (neuroticism, extraversion, openness, agreeableness, and conscientiousness) useful for

developing psychological resilience and ego-resilience. Our study differs by establishing direct connections between personal traits and SCRes. In doing so, we extend understanding of how individual characteristics shape resilience, shedding light on the importance of aligning organisational and SCRes strategies with individuals' personal traits.

Finally, the potential for the SCM field to enrich MRT has been underexploited by SCM scholars (Craighead, Cheng, and Ketchen 2024). Among scholars who have integrated MRT to explore SCM issues, Pellathy et al. (2018) investigate logistics customer service in the context of customer supply chain geography; Russo, Pellathy, and Omar (2021) explore an outsourced reverse supply chain in the context of a manufacturer's willingness to cede control over its operations; and Malik and Ali (2024) examine the effectiveness of SCRes in copetition, multi-sourcing, and supply chain collaboration and agility conditions. SCM researchers have identified numerous contexts affecting SCRes, often within the framework of the resource-based view, social network theory, or dynamic capabilities (see Table 1). Few have adopted MRT to understand why and when different contexts affect the operation of specific mechanisms associated with SCRes. In our study, we take an initial step in illustrating how SCRes can be achieved through the collective efforts of individuals, organisations, and supply chains in China's PESTELC environments. Our unique contributions to MRT are threefold. First, from a contextual perspective, our study includes more contexts in analysing SCRes, in terms of PESTELC environments. Second, from a mechanism perspective, we are amongst the first to propose that achieving SCRes depends on the collective efforts of individuals, organisations, supply chains, and the broader environments. Third, we extend the applicability

of MRT to understanding how to respond to and recover from floods.

## 5.2. Managerial implications

### 5.2.1. Managerial implications to supply chain managers

Our findings offer practical guidance for supply chain managers seeking to strengthen organisational and SCRes to disruptions. During the preparation phase, managers should consider deploying a range of strategies, including joint drills, buffer stock placement, backup suppliers, and alert protocols. For example, when conducting joint drills, supply chain managers particularly those in focal firms within AFSCs, should establish a multi-stakeholder coordination network that involves key participants and develop clear communication protocols, such as shared communication channel. Using historical flood data and climate models, managers can design exercises to test communication and coordination systems, practice the use of relevant equipment, and prepare essential materials such as sandbags. Regularly conducting such joint drills is essential to ensure that preparedness capabilities are continuously strengthened. Regarding buffer stock placement, supply chain managers could consider maintaining higher than normal inventory levels when the probability of flooding is elevated, as indicated by weather forecasts and historical flood records. These buffer stocks may include items such as seeds, agrichemicals, and components for agricultural machinery, as these products are suitable for long-term storage. In terms of alert protocols, supply chain managers could establish a tiered flood alert system comprising distinct alert levels (e.g. awareness, preparedness, activation, and emergency), along with corresponding triggers and recommended actions. At level 1 (awareness), for instance, a trigger could be a heavy rainfall forecast or indications of minor flooding, with associated actions including monitoring weather conditions, checking communication tools, confirming emergency contact lists. At level 4 (emergency), a possible trigger could be floodwater approaching the site, with corresponding actions such as shutting down electrical systems and machinery and evacuating all personnel to designated safe areas. Given the increasing frequency and severity of natural disasters driven by climate change, managers may also need to incorporate financial instruments such as flood insurance to mitigate the impact of future flooding events. At this stage, individuals characterised by conscientiousness, reliability, and extraversion are particularly valuable, as the effective implementation of these strategies requires extensive coordination and careful attention to details.

During the response phase, managers should adopt a range of strategies at both the organisational and supply chain levels. At the organisational level, flexibility-oriented strategies such as flexible and remote working arrangements, flexible decision-making, flexible planning should be prioritised. Additional practices, including intra-organisational information sharing, top management support, and the use of rewards and penalties, can further enhance responsiveness. This is particularly important in the face of floods or other natural disasters, when fear and uncertainty may

hinder action, and incentive mechanisms can help ensure the effective implementation of relevant strategies. At the supply chain level, resilience can be strengthened through practices such as information sharing across firms and the use of postpone strategies. For example, when implementing postpone strategies, managers can temporarily delay production until the risk subsides, or facilities are verified as safe. Alternatively, they can adopt inventory postponement by storing inventory at strategic upstream locations (e.g. with suppliers) rather than distributing it to downstream nodes that are at higher risk of flooding. At this stage, individuals characterised with courage, ambition, energy, flexibility, extraversion, and conscientiousness are particularly valuable for implementing relevant strategies, as danger may persist and continuous overtime work may be required.

During the recovery phase, several strategies are recommended for supply chain managers. At the organisational level, flexible transportation options should be considered, particularly when major roads are blocked due to floods. Psychological consulting services can be critical for addressing employees' mental health needs, while access to additional financial resources and bank credit often determines whether a disrupted organisation can successfully recover. Furthermore, strong leadership from the top management team is essential to reinforce organisational cohesion during this period. For example, establish a recovery task force led by top management team members, identify critical functions (e.g. logistics, communication, and finance) to be restored first, and approve flexible budgets for urgent repairs and alternative logistics options. At the supply chain level, recovery relies on practices such as information sharing, resource sharing, diversification of customers and suppliers, and sustained support from government agencies. For example, supply chain partners can mutually support one another by sharing physical, financial, human, and informational resources to restore operations after a flood. Such resources may include access to unaffected warehouses, cold storage facilities, vehicles, or production lines, and the development of joint recovery funds or shared insurance schemes. Successful recovery also depends on individuals possessing appropriate personal traits; therefore, those characterised by reliability, extraversion, openness, and loyalty are particularly valuable during this phase.

Finally, during the adaptation phase, several strategies are recommended. At the supply chain level, digitalisation of AFSCs through cloud-based or enterprise resource planning systems can facilitate the integration of information across multiple practitioners. Digital marketplaces and e-commerce platforms may help reach a broader consumer base, while predictive analytics can provide early warnings of floods. At the organisational level, deploying electricity generators can mitigate the high probability of power failures during floods. In addition, strengthening employees' loyalty through team-building activities, milestone celebrations, and mentoring programs can support long-term loyalty. At this stage, individuals characterised by such as curiosity, openness, and extraversion are particularly valuable, as significant coordination is required, and curiosity-driven behaviours can

	<b>Preparation</b>	<b>Response</b>	<b>Recovery</b>	<b>Adaptation</b>
<b>Suggested SCRes strategies</b>	Joint drills Buffer stock placement Alert protocols Backup suppliers	Information sharing across firms Postpone strategies	Information sharing Resource sharing Diversification of customers and suppliers Sustained support from government agencies	Deployment of cloud-based and enterprise resources planning systems Digital marketplaces and e-commerce platforms Predictive analytics
<b>Suggested organizational strategies</b>	Flood insurance Essential equipment and materials for flood preparation	Flexibility-oriented strategies Top management team support Use of rewards and penalties	Flexible transportation Psychological consulting services Additional financial resources and bank credit Strong leadership from the top management team	Deployment of electricity generators Strengthen employees' loyalty through team building activities
<b>Suggested personal traits</b>	Conscientiousness Reliability Extraversion	Conscientiousness Ambitiousness Energetic Flexible Extraversion Courageous	Reliability Loyalty Extraversion Openness	Curiosity Reliability Extraversion Persistence Loyalty Conscientiousness

Figure 9. Managerial implications to supply chain managers.

generate innovative approaches to strengthen adaptation efforts. Figure 9 illustrates the managerial implications to supply chain managers.

### 5.2.2. Managerial implications to policymakers

Our findings also offer valuable insights for policymakers aiming to more effectively support organisations and supply chains in managing flood-related disruptions. During the preparation phase, policymakers such as meteorological departments should closely monitor rainfall and disseminate timely weather information through multiple channels, including new media platforms. When there is a risk of flooding, they should issue prompt flood warnings to all individuals potentially affected. Moreover, governments can disseminate disaster prevention knowledge and skills through various activities, such as public awareness campaigns, flyers, posters, and educational videos to enhance individual, organisational, and community preparedness.

During the response phase, governments can adopt several measures to support affected communities and supply chains. For example, they should provide frequent and timely weather forecasts (e.g. every two hours) and disseminate this information widely via mobile messaging to all individuals. Additionally, crop-specific advisories indicating which crops should be harvested immediately and which fields require protection can guide farmers' actions. Governments should also consider alternative transport routes when roads are flooded, deploy vehicles, boats or helicopters to transport critical goods or inputs, and establish temporary collection and distribution hubs for agri-food products. Financial and resource assistance is equally important; thus, governments should activate emergency funds or grants to cover immediate operational losses, ensuring fast-track approvals for

timely support. To enhance the effectiveness of government response, the Commission for Discipline Inspection should establish accountability mechanisms for flood management, ensuring that officials are held responsible for delayed or inaccurate reporting of flood-related information.

During the recovery phase, governments can assess agri-food production losses and warehouse damage using satellite imagery to guide resource allocation. They can provide financial support to affected enterprises through measures such as tax relief, access to credit, and low-interest loans. Additionally, agricultural experts can be dispatched to flooded areas to offer on-site guidance, while coordination with local carriers can ensure the continuity of last-mile delivery of critical goods.

During the adaptation phase, a four-level chain-leader system encompassing provincial, municipal, county, and township-level government leaders should be established to support adaptive measures. Leaders in hierarchical systems possess significant authority to coordinate resources for development and most enterprises are located across different towns. This proposed structure differs from the currently adopted three-level chain-leader system, offering more localised coordination and stronger resource integration. Furthermore, long-term financial support, including credit and incentives, should be provided until agricultural infrastructure is fully restored. Figure 10 presents the managerial implications to policymakers. Regarding preferred personal traits, in hierarchical cultural environments particularly within governmental organisations, individuals are expected to follow the guidance of higher-ranking officials. Consequently, those characterised by conscientiousness, energetic, courageous, loyalty, reliability, and persistence are especially well-suited for roles in these contexts.

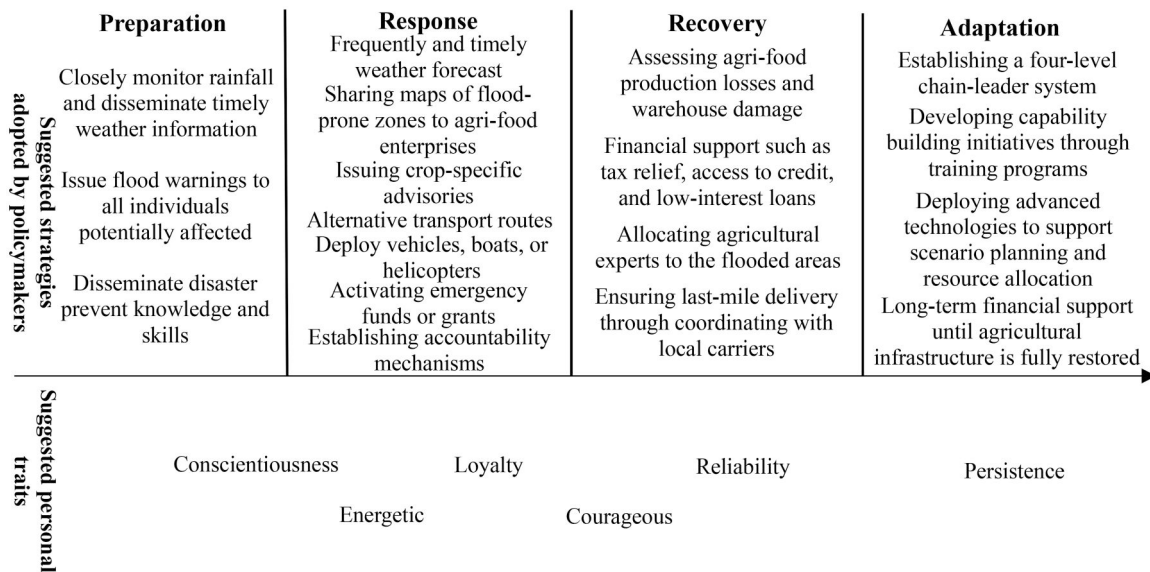


Figure 10. Managerial implications to policymakers.

## 6. Conclusions, limitations, and future research directions

Despite burgeoning SCRes research, its fragmentation, disconnection, and inconsistency limit understanding of the topic. Our study responds to the call to understand SCRes from a systems perspective (Adobor 2019; Wieland and Durach 2021). Thus, applying MRT to investigate SCRes in relation to the 2021 Henan floods has enabled us to update exist SCRes understandings by building a multi-level SCRes framework. In this framework, PESTELC environments are responsible for providing sustainable financial, technological, and policy resources to organisations and supply chains to support their recovery and adaptation; the organisational level is the transmission layer responsible for disseminating recovery and adaptation goals to individuals; and individuals with appropriate personal attributes are responsible for implementing organisational and SCRes strategies. Our findings also reveal 11 personal attributes, including extraversion and persistence, critical to implementing organisational and SCRes strategies across the response, recovery, and adaptation. Finally, our results show that successful flood survival also depends on China's hierarchical cultural environment, chain leader system, and accountability mechanisms. Overall, our findings present intriguing insights into the organisational and SCRes strategies adopted across the preparation, response, recovery, and adaptation phases of the floods, differentiating the roles of individuals, organisations, supply chains, and environments in achieving SCRes, and offering an integrated framework to expand SCRes knowledge boundaries.

### 6.1. Limitations and future research directions

Despite advancing knowledge and making theoretical and managerial contributions, this study has limitations that suggest avenues for future research.

First, this study develops a multi-level SCRes framework based on empirical data collected from 54 Chinese AFSC practitioners who experienced a flood. However, these

boundary conditions may limit the generalisability of the findings. For example, floods are sudden-onset disasters triggered by hazardous events that occur quickly or unexpectedly, which differ in characteristics from slow-onset disasters, such as droughts, sea-level rise, and epidemic diseases, which emerge gradually over time (United Nations Office for Disaster Risk Reduction 2017). Agri-food products, such as vegetables, are highly perishable and sensitive to environmental conditions. Moreover, the unique Chinese cultural context is characterised by exceptionally strong hierarchical cultural value orientations, which contribute to robust public coordination capabilities (Schwartz 2006). The associated chain leader system may ensure that individuals and organisations implement relevant response, recovery, and adaptation strategies. These boundary conditions may mean that the organisational and SCRes strategies, frameworks, and mechanisms identified in this study, such as resource sharing to enhance collaboration or the use of rewards and penalties, maybe less straightforward to apply in countries with different cultural characteristics, in disasters with distinct characteristics from floods, or in other types of supply chains such as manufacturing. Future research is therefore needed to examine how these strategies can be adapted and implemented in contexts that reflect Schwartz's (2006) other cultural dimensions, such as affective autonomy, intellectual autonomy, egalitarianism, harmony, embeddedness, and mastery, and to examine their effectiveness across different types of disasters and supply chains. This could be achieved through survey-based evaluations to assess whether the strategies, mechanisms, or frameworks found effective in this study are also applicable in other settings. In doing so, future research may generate new SCRes strategies that are more generalisable, such as mutual aid agreement, data sharing protocols, and incident command structures.

Second, a comprehensive understanding of the multi-level SCRes framework requires analysis of how the individual, organisational, supply chain, and environmental levels interact. Our study provides an initial understanding of interactions between the supply chain and organisational levels, and between the organisational and individual levels. However, we did not explore direct interactions between the environmental and individual levels, nor between the supply chain and individual levels. Since all four levels work collectively to achieve SCRes, exploration of interactions between these levels and their influence on SCRes is another promising future research direction.

Third, our study generated six propositions using widely accepted qualitative techniques; however, these propositions were not empirically verified. We acknowledge this limitation and suggest that future studies could employ alternative qualitative approaches such as embedding researchers within similar socio-cultural contexts to observe and validate these propositions.

Finally, we have built a multi-level resilience framework that includes the basic elements of a supply chain. Sarkis, Kouhizadeh, and Zhu (2020) highlight that supply chain analysis may occur at six levels, as well as at the group or team level and the global industrial network level. Future research is thus needed to understand SCRes by considering interactions between these six levels.

## Author contributions

CRediT: **Guoqing Zhao**: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing; **Mar Vazquez-Noguerol**: Conceptualization, Investigation, Methodology, Writing – review & editing; **Denis Dennehy**: Writing – review & editing; **J. Carlos Prado-Prado**: Conceptualization, Data curation, Writing – review & editing.

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**Paper identification and selection process:** To gain deeper insights into SCRes and enhance the credibility of this study, our review focused on top-tier, empirically focused journals in the SCM Journal List (2024), including *Decision Sciences*, *Journal of Business Logistics*, *Journal of Operations Management*, and *Journal of Supply Chain Management*. We searched for and selected relevant papers from these four journals for further analysis, using keywords such as "resilient", "resilience", "resiliency", "response", "recovery", "preparedness", "adaptation", "mitigation", and "disruption". Two senior PhD students with research interests in SCRes conducted the searches independently. They reviewed the title, abstract, introduction, conclusion, and research methodology of

## Appendix A. Empirical investigations of SCRes.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
Braunscheidel and Suresh (2009) <sup>3</sup>	Organizational antecedents of a firm's supply chain agility	Not specified	The cultural antecedents of market and learning orientation affect the organizational practices of internal integration, external integration with key suppliers and customers, and external flexibility, and ultimately impact on firms' supply chain agility	×	✓	×	✓
Pettit, Fiksel, and Croxton (2010) <sup>2</sup>	SCRes conceptual framework and capabilities	Not specified	SCRes capabilities include sourcing flexibility, visibility, collaboration, and financial strength	×	×	✓	×
Zsidisin and Wagner (2010) <sup>2</sup>	Testing the extent to which SCRes practices moderate disruption frequency	Not specified	The SCRes practices of flexibility and redundancy do not moderate the relationship between perceived risk from suppliers and disruption occurrence	×	×	✓	×
Blackhurst, Dunn, and Craighead (2011) <sup>2</sup>	Factors contributing to or detracting from supply resiliency	Systems theory and resource-based view	Supply resiliency enhancers are human, organizational, interorganizational, and physical capital resources, whereas detractors are flow activities and units, and sources of flow units	×	✓	✓	×
Boone et al. (2013) <sup>2</sup>	The impact of improved strategic alignment of inventory on resilience and continuity	Contingency theory	A well-aligned approach to inventory management is effective in improving continuity and resilience	×	✓	✓	×
Pettit, Croxton, and Fiksel (2013) <sup>2</sup>	Developing an SCRes and assessment tool	Not specified	A "SCRes Assessment and Management" measurement tool	×	×	✓	×
Talluri et al. (2013) <sup>2</sup>	Assessing the efficiency of SC risk mitigation strategies	Contingency theory	More efficient strategies focus on flexibility rather than redundancy for SC failures	×	×	✓	×
Brandon-Jones et al. (2014) <sup>4</sup>	Understanding SCRes and robustness from a contingent resource-based view	Resource-based view	Supply chain connectivity and information-sharing resources lead to supply chain visibility, which enhances SCRes and robustness	×	✓	✓	×
Tenhiälä and Salvador (2014) <sup>1</sup>	Examining the glitch mitigation capability of a production process	Information processing theory	The impacts of operational glitches on delivery performance are contingent on formalization of intra-firm communication channels, and are stronger when informal channels	×	✓	×	×

(continued)

## Appendix A. Continued.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
Ambulkar, Blackhurst, and Grawe (2015) <sup>3</sup>	Factors contributing to the development of firm resilience to supply chain disruptions	Resource configuration theory	Supply chain disruption-oriented firms must be able to reconfigure resources or have a risk management resource infrastructure to develop resilience	×	✓	×	×
Kim, Chen, and Linderman (2015) <sup>3</sup>	Conceptualizing supply network disruption and resilience by examining structural relationships among entities in the network	Graph theory	Different structural relationships among network entities exhibit differing levels of resilience	×	×	✓	×
Bode and Macdonald (2017) <sup>1</sup>	Decision-making processes and supply chain responses	Information processing theory	In the response process, accelerated recognition and implementation reduce disruption impact, but maybe less effective if the information gathered and processed as part of the diagnosis stage becomes a constraining factor and is not worked through quickly	×	✓	×	×
Reimann, Kosmol, and Kaufmann (2017) <sup>4</sup>	Responses to supplier-induced disruptions	Systems theory	Cognitive, behavioural, and structural factors across individual and organizational levels elicit constructive interactions	✓	✓	×	×
Duhadway, Carnovale, and Kannan (2018) <sup>4</sup>	The effects of organizational communication and individual behaviour on supply chain risk management	Risk compensation theory	Decision makers adapt sourcing strategies in response to organizational communications regarding supply chain risk	✓	✓	×	×
Kaufmann, Esslinger, and Carter (2018) <sup>4</sup>	Supply chain relationship resilience	Social exchange theory	Effective interorganizational trust repair can help to transform an interorganizational buyer-supplier relationship from adversarial to collaborative	×	×	✓	×
Timmer and Kaufmann (2019) <sup>4</sup>	Exploring the relationship between personal personality and firm resilience	Attribution theory	Dark personality traits are useful for coping with adverse supply chain events	✓	×	×	×
Zhao, Zuo, and Blackhurst (2019) <sup>3</sup>	Modelling supply chain adaptation for disruptions	Complex adaptive systems	A proactive strategy is positively associated with the unevenness of risk among a focal firm's suppliers	×	×	✓	×
Azadegan et al. (2020) <sup>1</sup>	Exploring the relationship between business continuity and supply chain disruptions	Contingency and information processing theories	Business continuity programmes are beneficial to companies with a procedural or flexible orientation in limiting the damage caused by supply chain disruptions	×	✓	×	×

(continued)

## Appendix A. Continued.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
Davis et al. (2020) <sup>3</sup>	Factors contributing to an emergency department's level of resilience	Not specified	Operational effectiveness and the patient experience can improve resilience at the departmental level	×	✓	×	×
Quarshie and Leuschner (2020) <sup>4</sup>	Exploring the role of government in disaster response networks	Not specified	Governments play three main roles of organizer, facilitator, and supply network member in interacting with other actors in disaster response network	×	✓	×	×
Chopra, Sodhi, and Lücker (2021) <sup>1</sup>	Multi-level commons to achieve SCRes	Not specified	Investing cautiously against disruptions, risk mitigation inventory, flexible capacity, omni-channel retailing, and tailored sourcing help to achieve SCRes	×	✓	✓	✓
Wiedmer et al. (2021) <sup>2</sup>	The impact of supply, logistics and product complexities on firm's resilience	Normal accident theory	Logistics complexity is beneficial during the disruption-recovery phase; product complexity is detrimental during the disruption-impact phase; and supply chain complexity plays a contradictory role during both phases	×	✓	✓	×
Chen, Li, and Linderman (2022) <sup>1</sup>	Defining and introducing supply network resilience learning	Organizational learning theory	Suppliers' <i>learning-to-prevent</i> results in a disruption-free supply network when time approaches infinity; <i>learning-to-recover</i> improves network learning when suppliers face a less chance of disruption	×	✓	✓	×
De Vries et al. (2022) <sup>4</sup>	When and how cross-functional teams ensure firm robustness	Information processing theory	A cross-functional team's ability to handle high numbers of SC disruption warnings depends on the extent to which the team adopts centralized decision-making	×	✓	×	×
Essuman et al. (2023) <sup>2</sup>	How and when firms activate spontaneous and creative improvisation during supply chain disruptions	Conservation of resources theory	Creative improvisation is positively related to SCRes, whereas spontaneous improvisation is unrelated	×	✓	×	×
Ge et al. (2023) <sup>3</sup>	The impact of working from home on firm resilience during the COVID-19 pandemic	Not specified	Working from home enhances firms' resistance capacity but decreases their recovery capacity	×	✓	×	×
Gerschberger, Ellis, and Gerschberger (2023) <sup>2</sup>	Employee attributes and organizational resilience	Not specified	Cognitive, emotional, and behavioural attributes leverage	✓	×	×	×

(continued)

## Appendix A. Continued.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
Hughes et al. (2023) <sup>2</sup>	Plastic response to disruptions	Change management theory	organizational resilience Acquisition of new skills, investment in new assets, leadership support, and a permanent new way of operating are required to achieve a plastic response	×	×	✓	×
Jiang et al. (2023) <sup>3</sup>	The effects of customer and supplier concentrations on firm resilience during the pandemic	Resource dependence theory	Customer concentration relates negatively to firm resilience in the disruption stage but has no effect in the restoration stage; supplier concentration relates positively to firm resilience in the disruption stage but undermines it in the restoration stage	×	✓	×	×
Li et al. (2023) <sup>3</sup>	Exploring how firms effectively match their internal competences with external resources from the supply chain network to achieve operational resilience	Matching theory	More heterogeneous matchings between internal (external) flexibility and external (internal) stability have a complementary effect that enhances operational resilience, whereas more homogeneous matchings between internal flexibility (or stability) and external flexibility (or stability) have a substitutive effect that reduces operational resilience	×	✓	×	×
Müller, Hoberg, and Fransoo (2023) <sup>3</sup>	Supply chain agility under time pressure	Dynamic capabilities theory	Dynamic capabilities enable companies to build ad hoc supply chains in response to specific needs, moderated by an entrepreneurial orientation allowing firms to leverage dynamic capabilities at short notice and a temporary orientation	×	✓	✓	×
Polyviou et al. (2023) <sup>2</sup>	The impact of supply base concentration on supply disruptions	Resource dependence theory	Higher pre-disruption supplier concentration and supplier country concentration helps buyers to mitigate supply disruptions, and higher pre-disruption carrier diversification helps mitigate the impact of supply disruptions	×	×	✓	×
Qi et al. (2023) <sup>3</sup>	The impacts of integration between an e-commerce	Not specified	Integration between an e-commerce platform and suppliers for	×	✓	✓	×

(continued)

## Appendix A. Continued.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
	platform and suppliers on SCRes		information sharing, joint planning, and logistical cooperation has positive impacts on SCRes, while procurement automation has the opposite effect				
Shen and Sun (2023) <sup>3</sup>	Analyzing the impact of the pandemic on SCRes	Not specified	An integrated supply chain structure and comprehensive intelligent platforms are effective in tackling pandemic disruptions	×	✓	✓	×
Durach et al. (2024) <sup>3</sup>	How inventory slack in first- and second-tier suppliers influences buyer performance following an upstream disruption event	Resource-based view	Important resources are controlled by chain members with indirect links to the buyer, with a bridging role played by first-tier suppliers	×	✓	×	×
Guntuka, Carnovale, and Falcone (2024) <sup>2</sup>	Supply chain plasticity	Network theory	Significant network plasticity in shaping firm responses to disruptions is present and may be beneficial	×	×	✓	×
Jiang, Feng, and Huang (2024) <sup>3</sup>	Configurations of different antecedents regarding supply chain integration and big data analytics capability to develop SCRes	Resource orchestration theory	Antecedent configurations in building proactive and reactive SCRes are not identical	×	✓	✓	×
Nikookar, Stevenson, and Varsei (2024) <sup>4</sup>	Antifragile supply chain	Not specified	Five key capabilities for building antifragility are supply chain mindfulness, transformative learning, plasticity, bricolage, and collaboration	×	×	✓	×
Razak, Stevenson, and Hendry (2024) <sup>4</sup>	The role of the cultural environment in achieving traceability and global SCRes	The relational view	Maintaining social ties is more important than short-term economic gains in a collectivist culture, leading to greater relational rents in the long term	×	×	×	✓
Umar and Wilson (2024) <sup>2</sup>	How inherent resilience works synergistically with adaptive resilience	Not specified	Sources of inherent resilience are the network structure, buffer capacity, and strong social connections among actors; adaptive resilience is derived from transportation flows, storage, information sharing, and demand management processes	×	×	✓	×
Zhao et al. (2024a) <sup>2</sup>	Understanding SCRes in two cultural environments	MRT	A hierarchical/egalitarian cultural orientation contributes to supply chain/organizational	×	×	✓	✓

(continued)

**Appendix A.** Continued.

Author(s) (year)	Topic focus	Theory adopted	Findings	Investigating SCRes at different levels			
				Individual	Organizational	SC	Environmental
This study addresses SCRes	Understanding SCRes as a multi-level framework	MRT	response and recovery Achievement of SCRes depends on the collective efforts and interactions of individuals, organizations, supply chains, and associated PESTELC environments	✓	✓	✓	✓

**Note:** 1 – *Decision Sciences*, 2 – *Journal of Business Logistics*, 3 – *Journal of Operations Management*, 4 – *Journal of Supply Chain Management*; ✓ the study provides empirical evidence; × the study does not provide empirical evidence.

each relevant paper to ensure inclusion of the most relevant studies. Only empirical studies were included for further analysis, while literature reviews and theoretical and conceptual papers were excluded. A professor specialising in SCM was consulted to resolve any disagreement between the students. As a result, we identified 41 papers from the four top-tier, empirically focused journals.

**Appendix B. Reliability and validity issues addressed throughout the research.**

Reliability/validity criterion	Measures adopted
Reliability: demonstrating that the same insights can be produced by performing the same operations	<ul style="list-style-type: none"> <li>• Development of a case study protocol based on multiple roundtable discussions</li> <li>• Development and use of a case study database</li> <li>• Development of semi-structured interview guidelines</li> <li>• Involvement of two SCRes researchers fluent in Chinese to collect data in China</li> <li>• Development of specific criteria to select agri-food organizations and respondents</li> </ul>
Internal validity: establishing causal relationships whereby certain conditions are believed to lead to specific results	<ul style="list-style-type: none"> <li>• Rigorous coding process</li> <li>• Building an SCRes framework based on established literature on SCRes and middle-range and grand theories</li> <li>• Interviewing multiple knowledgeable respondents</li> <li>• Development of a coding protocol to achieve consistency between two coders</li> </ul>
Construct validity: referring to the quality of the conceptualization or operationalization of the relevant concept	<ul style="list-style-type: none"> <li>• Full transcriptions of interviews sent to interviewees for checking</li> <li>• Triangulation of data between interviews and archival data</li> <li>• Collection and use of multiple sources of information</li> <li>• Participant diversity, for example involving participants with varied expertise and positions</li> </ul>
External validity: establishing whether and how a case study's findings can be generalized	<ul style="list-style-type: none"> <li>• Data triangulation</li> <li>• Clear rationale for the case study selection</li> <li>• Inclusion of nine different agri-food organizations for analysis</li> <li>• Theoretical sampling using replication logic, both literal and theoretical</li> <li>• Gathering data on the case contexts</li> <li>• Adoption of MRT for theory matching</li> </ul>

**Notes:** Kaufmann and Denk (2011); Yin (2018).

## Appendix C. Archive data complementing the study.

Representative documents	Quotes from documents	Source
Investigation and disaster report 7.20: Extremely heavy rainfall in Zhengzhou, Henan	<ul style="list-style-type: none"> <li>■ “From 17 to 23 July 2021, Henan province suffered a historically rare heavy rainstorm and suffered severe floods.”</li> </ul>	The State Council (2022)
Henan Provincial Finance allocated 15 million yuan to support water conservancy and disaster relief	<ul style="list-style-type: none"> <li>■ “The provincial finance department further increased fund-raising efforts, and released ¥15 million in water conservancy relief funds in addition to the ¥10 million in natural disaster relief funds previously allocated.”</li> </ul>	Henan Provincial Department of Finance (2023)
Water withdrawal in the flood storage and detention area in Xunxian County has basically been completed	<ul style="list-style-type: none"> <li>■ “In order to speed up the progress of flood and soil pollution reduction in Xunxian County, the Provincial Department of Water Resources promptly coordinated the deployment of eight loads of large-scale drainage equipment to Xunxian County.”</li> </ul>	Henan Provincial Department of Agriculture and Rural Affairs (2021)
China: 69 dead, 5 still missing in Henan floods	<ul style="list-style-type: none"> <li>■ “As of 26 July, heavy rain and floods had affected 12.9 million people and 150 counties and 1,558 towns across Henan.”</li> </ul>	Davies (2021)
China: Floods and landslides in southwest leave 17 dead, 6 missing	<ul style="list-style-type: none"> <li>■ “Heavy rainfall has also caused problems in eastern parts of the country over the last few days, in particular in the provinces of Anhui and Henan on 1 June 2023.”</li> </ul>	Davies (2023)
Measures for the management of emergency plans for production safety accidents	<ul style="list-style-type: none"> <li>■ “The production and business units should have emergency plans for various situations, including comprehensive emergency plans, special emergency plans and on-site disposal plans.”</li> </ul>	Henan Provincial Department of Emergency Management (2024)
Henan province flood control emergency plan	<ul style="list-style-type: none"> <li>■ “The provincial meteorological bureau reports rain monitoring and weather forecasts every two hours. During this period, the forecasts are updated in real time based on the monitoring conditions, and emergency reports are reported at any time.”</li> </ul>	Henan Provincial Department of Emergency Management (2024)
Compensation standards for flood storage and detention areas in Henan Province	<ul style="list-style-type: none"> <li>■ “Relevant provincial departments have studied and formulated compensation standards for crops, economic forests, professional breeding, household durable consumer goods, etc.”</li> </ul>	Henan Provincial Government (2021)
Post-disaster recovery and reconstruction plan for Zhengzhou and other places	<ul style="list-style-type: none"> <li>■ “According to the situation, priority will be given to supporting the construction of high-quality farmland in disaster areas, restoring damaged field roads, irrigation, drainage, and distribution.”</li> </ul>	National Development and Reform Commission (2022)
Henan province’s fiscal budget has allocated a total of ¥84.128 billion to support post-disaster recovery and reconstruction	<ul style="list-style-type: none"> <li>■ “The provincial finance department coordinated ¥90 billion in central and provincial funds and secured a ¥1 billion emergency preferential loan from the Asian Infrastructure Investment Bank to provide strong financial guarantees for post-disaster recovery and reconstruction.”</li> </ul>	Ming (2022)
After the flood, the “Central Plains Granary” accelerated reconstruction	<ul style="list-style-type: none"> <li>■ “The Henan Provincial Department of Agricultural and Rural Affairs also dispatched nine working groups led by department-level officials and 22 expert service groups to visit disaster areas to guide disaster relief and post-disaster recovery production.”</li> </ul>	Wang and Cao (2021)
Henan Audit Department report	<ul style="list-style-type: none"> <li>■ “More than ¥9 billion in post-disaster reconstruction funds were found problematic, and 41 banks illegally disposed of ¥10 billion in non-performing assets.”</li> </ul>	Cheng (2023)
Henan: Grain production is a trump card.	<ul style="list-style-type: none"> <li>■ “In 2022, Henan’s grain output will be 136 billion kilograms. By 2025, it is certain that grain production capacity will increase by 10 billion kgs and reach to 140 billion kgs.”</li> </ul>	Henan Provincial Development and Reform Commission (2024)

## Appendix D. Interview guide

### Section 1. Introductory questions to understand interviewee's and company's backgrounds

#### A. Interviewee background information

1. What is your current designation?
2. Can you give me a brief overview of your job within the company's operations?
3. How many years have you been working in this company?
4. How many years have you worked in relevant areas?

#### B. Company background information

1. Can you give me a brief overview of the company structure and its operations (e.g. locations, departments, number of employees, and main businesses)?

### Section 2. SCRes ecosystem: a multi-level SCRes framework

#### A. Organisation's contribution to SCRes

1. How would your company prepare for a flood?
2. In the face of a flood, how would your company respond and recover?
3. After experiencing a flood, what would be internalised as part of the organisation?
4. How would your company evolve to develop capabilities for supply chain reorientation and repurposing to enhance SCRes?

#### B. Individual's contribution to SCRes

1. How would you prepare for a flood?
2. In the face of a flood, how would you help your company to respond and recover?
3. After experiencing a flood, what you would learn and improve in yourself to face the same issues in the future?
4. How would you evolve to develop capabilities to reorientate and repurpose the organisation to enhance organisational resilience, and thereby enhance SCRes?
5. What kind of employee characteristics do you think are important for your organisational resilience building?

#### C. Environment's contribution to SCRes

1. How do you think changes in social environments can impact your organisation's preparation for, response to, recovery from, and adaptation after a flood?
2. How do you think changes in policy environments can impact your organisation's preparation for, response to, recovery from, and adaptation after a flood?
3. How do you think changes in economic environments can impact your organisation's preparation for, response to, recovery from, and adaptation after a flood?
4. How do you think changes in technological environments can impact your organisation's preparation for, response to, recovery from, and adaptation after a flood?
5. How do you think other forces originating from the environment might affect your decisions on preparing, responding, recovering and adapting from a flood?
6. After experiencing a flood, how might your company evolve to develop capabilities for supply chain reorientation and repurposing, and thereby enhance SCRes?

## Appendix E. Empirical evidence of cross-level interactions

### Appendix E1. Cross-level interactions during the preparation phase.

First-order codes	Second-order themes	Cross-level interactions
<ul style="list-style-type: none"> <li>• "Everything was in chaos because infrastructure had been destroyed by the floods and uncertainty was increasing. It became difficult to coordinate with our supply chain partners, as they were also affected."</li> <li>• "At the beginning of the floods, supply chain partners prioritized their own tasks, while the government was also occupied with rescue operations. As a result, supply chains lacked coordination."</li> </ul>	Lack of coordination	Supply chain – Organizational
<ul style="list-style-type: none"> <li>• "Our organization did not have any training related to floods, as our organization had not encountered such events for many years."</li> <li>• "As many businesses have not experienced severe flooding for a long time, they tend to focus more on daily operational efficiency while neglecting disaster preparedness. As a result, employees often lack the necessary knowledge, experience, and adaptability to prepare for the floods."</li> </ul>	Lack of trainings	Organizational – Individual
<ul style="list-style-type: none"> <li>• "Our company has developed an emergency response plan; however, our company do not conduct regular drills, making it difficult for employees to fully master the procedures."</li> <li>• "Employees may not know what emergency measures to take before a flood, mainly because they have not received relevant training."</li> </ul>	Lack of preparation	Individual – Organizational
<ul style="list-style-type: none"> <li>• "There is no flood risk assessment mechanism, resulting in a failure to identify potential risks related to suppliers, logistics, and warehousing in a timely manner."</li> <li>• "Companies lack continuous monitoring of extreme weather changes, this resulting them without the ability to prepare backup inventory or alternative suppliers in advance."</li> </ul>	Lack an approach to identify flood risk	Organizational – Supply chain

## Appendix E2. Cross-level interactions during the response phase.

First-order codes	Second-order themes	Cross-level interactions
<ul style="list-style-type: none"> <li>• “When other organizations in the supply chain learn that upstream companies have been affected by the flood, suppliers would prioritize supplying goods to the affected areas.”</li> <li>• “Logistics companies are willing to adjust their routes to support affected supermarkets.”</li> </ul>	Empathy and collectiveness	Supply chain – Organizational
<ul style="list-style-type: none"> <li>• “Our company may prefer to select psychologically stable employees with strong stress resistance to undertake key tasks, which can help to some extent improve emergency response efficiency.”</li> <li>• “Some highly ambitious employees were assigned to undertake key tasks.”</li> </ul>	Tasks allocated to appropriate individuals	Organizational – Individual
<ul style="list-style-type: none"> <li>• “Extroverted individuals tend to be more proactive in communicating information with upstream and downstream partners and are better at coordinating cross-departmental and cross-organizational resources.”</li> <li>• “Individuals who are more rule-abiding and compliant are more likely to complete tasks efficiently during emergency response situations.”</li> </ul>	Individuals effectively and efficiently complete tasks	Individual – Organizational
<ul style="list-style-type: none"> <li>• “Our company honestly reported its losses and production status to upstream and downstream supply chain partners.”</li> <li>• “Our company will gradually disclose information about its losses to increase transparency and facilitate adjustments to transportation routes and production capacity by other supply chain partners.”</li> </ul>	Honesty	Organizational – Supply chain

## Appendix E3. Cross-level interactions during the recovery phase.

First-order codes	Second-order themes	Cross-level interactions
<ul style="list-style-type: none"> <li>• “Core enterprise in the supply chain set targets for resuming work and production and established a unified recovery direction during the post-disaster recovery phase.”</li> <li>• “The government will also provide incentives to companies that prioritize resuming work and production.”</li> </ul>	Set recovery goals to support development	Supply chain – Organizational
<ul style="list-style-type: none"> <li>• “Our company requires substantial resources during the production recovery phase, so outgoing individuals are needed to facilitate coordination and communication.”</li> <li>• “We would like to assign tasks based on individuals’ characteristics.”</li> </ul>	Allocate tasks to appropriate individuals	Organizational – Individual
<ul style="list-style-type: none"> <li>• “During the recovery phase, individuals required additional resources to complete relevant tasks, such as meeting delivery deadlines.”</li> <li>• “To compensate for disaster-related losses and restore customer trust, individuals or teams may request additional resources.”</li> </ul>	Acquiring resources complete tasks	Individual – Organizational
<ul style="list-style-type: none"> <li>• “We contacted upstream and downstream companies to ensure that the coordinated restoration of raw material supplies and customer orders.”</li> <li>• “Since most businesses in this area were affected by the floods, we contacted both raw material suppliers and companies requiring supplies.”</li> </ul>	Coordination to achieve synergies	Organizational – Supply chain

## Appendix E4. Cross-level interactions during the adaptation phase.

First-order codes	Second-order themes	Cross-level interactions
<ul style="list-style-type: none"> <li>• "The core enterprises of the supply chain developed new goals to adapt to climate change-induced extreme weather conditions, such as chain-level scenario emergency training and supply chain digitalization."</li> </ul>	Setting adaptation goals for organizations	Supply chain – Organizational
<ul style="list-style-type: none"> <li>• "Strengthening resilience to cope with the normalization of extreme weather conditions."</li> <li>• "We also prefer to assign tasks to the most suitable individuals."</li> </ul>	Allocating adaptation tasks to appropriate individuals	Organizational – Individual
<ul style="list-style-type: none"> <li>• "Because developing resilience is a long-term endeavour, individuals with strong perseverance are better suited for such tasks."</li> <li>• "At the adaptation phase, enhancing resilience requires long-term investment, and greater financial, technological, and organizational resources are needed."</li> </ul>	Acquiring resources to complete tasks	Individual – Organizational
<ul style="list-style-type: none"> <li>• "We need seek support from top management teams in order to complete relevant tasks."</li> <li>• "Climate change is a systemic risk, and our company needs to coordinate with other supply chain stakeholders to drive necessary changes."</li> </ul>	Coordinate with other stakeholders to achieve synergies	Organizational – Supply chain
<ul style="list-style-type: none"> <li>• "Through the synergy of strategy, information, resources, and structure, the entire supply chain can be driven to transition from a recovery state to a state of long-term resilience."</li> </ul>		