Journal of Applied Economics and Policy Studies Vol.18 Issue 11 EWA Publishing
Available Online: 30 December 2025 DOI: 10.54254/2977-5701/2025.31015

From early warning to resilience: adaptive governance of urban public security systems under peak passenger flow—a case study of Harbin's ice and snow tourism

Ming Ni[1], *Qian Gong*[12*]

[1]School of Economics, Management and Law, Changchun Normal University, Changchun, China
[2]School of Public Administration, Jilin University, Changchun, China

*Corresponding Author. Email: gongqian@ccsfu.edu.cn

Abstract. In the era of mass tourism, peak passenger flow triggered by large-scale cultural and tourism activities has exposed urban public security to severe risk aggregation and systemic challenges. Taking the phenomenal event of "Harbin's ice and snow tourism" as the research object, this paper introduces the theoretical lens of "mechanism resilience" and constructs an analytical framework covering agile perception, precise release, and linked regulation. Through case analysis, it is found that its early warning mechanism has demonstrated certain resilience characteristics in using multi-source data for risk identification, relying on user-friendly channels for information transmission, and rapid disposal of specific scenarios. However, inherent vulnerabilities have been exposed in terms of the depth of data integration, the smoothness of cross-departmental collaboration, the accuracy of early warning instructions, and the decisiveness of "circuit breaker" decisions under extreme scenarios. Based on this, this paper systematically proposes an optimization path for building a resilient early warning system from three dimensions: technological empowerment, management innovation, and social co-governance, aiming to provide theoretical reference and practical guidance for similar cities to respond to peak passenger flow risks.

Keywords: peak passenger flow, public security, early warning mechanism, resilience governance

1. Introduction

The arrival of the era of mass tourism has spawned an unprecedented scale of periodic passenger flow migration. In 2024, the domestic tourist arrivals reached as high as 5.615 billion, which highly concentrated in some "Internet-famous cities" within specific time and space, forming a "peak passenger flow" far exceeding the environmental and social carrying capacity thresholds. This instantaneous and high-density passenger flow not only directly amplifies traditional public security risks such as stampedes and traffic paralysis but also poses a systemic challenge to the static emergency management model based on the "predict-response" paradigm, exposing its governance limitations in the face of uncertainty and non-linear disturbances. Against this background, the phenomenal tourism boom of Harbin triggered by the "ice and snow fever" and its early warning practices in responding to extreme passenger flow pressure have become a highly representative real-world sample. It clearly reflects the urgency and complexity of the transformation of urban public security systems from traditional "early warning" to modern "resilience," providing a valuable observation window for this study to explore the core issue of "adaptive governance."

This paper aims to address a set of interrelated core questions through in-depth analysis of this case: In the face of highly uncertain and dynamically evolving peak passenger flow, in which links has Harbin's public security early warning system demonstrated the resilient characteristics of adaptive governance? At which key nodes has it exposed its systemic vulnerabilities and insufficient adaptive capacity? More importantly, how does this case inspire us to systematically construct a new paradigm of public security governance that can achieve a shift from passive early warning to active adaptation and from rigid control to flexible recovery from the dimensions of technology, institutions, and actor networks?

Based on the above questions, this paper constructs a progressive research path of "theoretical framework—diagnostic analysis—path optimization." Firstly, integrating complex adaptive systems theory and resilience governance ideas, an integrated diagnostic framework focusing on "systemic vulnerability—structural resilience—adaptive capacity" is established. Subsequently, this framework is applied to the Harbin case to analyze the inherent root causes of its systemic vulnerability from three dimensions: exposure, sensitivity, and self-adaptive capacity, while evaluating its resilient behaviors in responding to

disturbances from three levels: agile perception, precise regulation, and collaborative linkage. Finally, based on the diagnostic conclusions, an optimization path for the system oriented towards "adaptive governance" is proposed. At the theoretical level, by incorporating both vulnerability analysis and resilience assessment into the explanatory scope of complex adaptive systems, this study breaks through the static perspective of traditional emergency management research, deepens the mechanistic understanding of why public security systems are "vulnerable" and "adaptable" under dynamic pressure, and provides a useful exploration for constructing a more explanatory urban governance theory. At the practical level, the research conclusions can not only provide specific references for Harbin and other tourist cities facing similar challenges to identify governance shortcomings and optimize response strategies but also aim to provide operable practical guidance for promoting a profound transformation of the urban public security governance paradigm from static control to dynamic adaptation and from technological upgrading to systematic governance.

2. Analytical framework of public security early warning mechanism based on complex adaptive systems theory

2.1. Definition of core concepts

2.1.1. Early warning mechanism

The early warning mechanism is a system that determines the alert level and corresponding warning color based on the predictive information and risk assessment of potential emergencies, taking into account factors such as the possible severity, urgency, and evolving nature of the incident. Relevant information is then released to the public accordingly [1].

2.1.2. Mechanism resilience

Refers to the ability of the public security early warning mechanism to maintain, restore, or even enhance its core early warning and response functions through rapid learning, self-adaptive adjustment, and collaborative innovation when facing extreme pressure disturbances such as peak passenger flow. This ability can be specifically operationalized into three core dimensions for observation: ① Agility: The capability for swift response and rapid recovery, which refers to efficiently and flexibly addressing issues in the face of disruptions or failures [2]; ② Accuracy: The ability of early warning information to effectively reach target groups and provide clear and operable action guidelines, thereby achieving precise avoidance and diversion of risks; ③ Collaboration: The ability of all relevant departments and subjects within the system to quickly activate and collaborate efficiently after the release of early warning information, forming an integrated response synergy to effectively handle risks.

2.1.3. Vulnerability

Another core analytical concept introduced in this paper to deepen the exploration of the root causes behind the performance of mechanism resilience. Vulnerability refers to the gaps or weaknesses in a system that can be exploited by potential threats. It does not reside in the data itself, but rather in the physical environment where data is processed, as well as in the associated hardware, software, networks, and personnel [3]. Vulnerability includes physical vulnerability, social vulnerability, economic vulnerability, and environmental vulnerability. This paper mainly analyzes it from two aspects:

(1) Social Vulnerability: Mainly refers to the systemic vulnerability composed of social factors such as management systems, organizational processes, information communication, and public cognition. For example, poor cross-departmental collaboration mechanisms, imperfect emergency plans, and weak public risk awareness.

(2) Environmental Vulnerability: Refers to the systemic vulnerability caused by regional natural environmental conditions and their changes. In this paper, it mainly refers to the inherent attribute of Harbin's ice and snow tourism season—extreme weather (such as low temperature, cold wave, heavy snow) acting as an external pressure source, which, when superimposed with peak passenger flow, significantly amplifies risks such as slips, frostbite, and traffic disruption. It is closely related to physical vulnerability but focuses on the hazard-causing factors of the natural environment.

2.2. Applicability of complex adaptive systems theory

Complex Adaptive Systems theory posits that "the interaction and synergy between internal drivers (i.e., agents and socio-cultural factors) and external drivers (i.e., institutional and technological factors) jointly promote the evolution of complex adaptive systems" [4]. The theoretical approach focuses on the interactions among the intrinsic elements of a system, thus adopting a "bottom-up" research methodology. Its analytical depth extends beyond merely describing objective phenomena;

rather, it places greater emphasis on uncovering the underlying causes of how such phenomena are constituted and the processes through which they evolve.

Drawing on this theoretical perspective, this paper regards the urban public security system as a complex adaptive system composed of the interaction of multiple types of "subjects" such as government departments, tourists, citizens, and enterprises. The formation and evolution of peak passenger flow are typical complex phenomena "emerged" from the non-linear interaction of subjects within the system. The resilience of the early warning mechanism is essentially the ability of internal subjects within the system to maintain core functions through self-adaptation, self-learning, and collaborative interaction under external shocks. This theory provides an in-depth explanatory framework for analyzing the root causes of the vulnerability of the early warning mechanism and the optimization path (Figure 1).

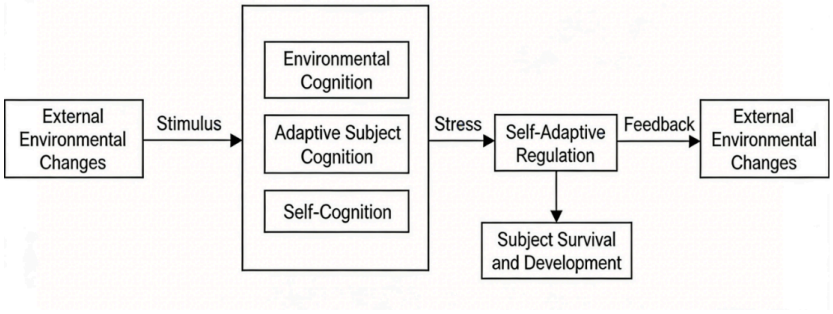

Figure 1. An Explanation Framework for the Vulnerabilities of Early Warning Mechanisms and Their Optimization Path

3. Case background: public security risk scenarios and governance challenges under Harbin's "ice and snow fever"

The phenomenal prosperity of Harbin's ice and snow tourism has exposed its public security system to a multi-dimensional and highly coupled risk complex (Table 1). To systematically deconstruct the internal structure of this risk scenario, this part relies on the analytical framework of vulnerability theory to conduct a systematic review of various risks from three dimensions: exposure, sensitivity, and adaptive capacity, aiming to reveal the inherent structural weaknesses and existing defense foundations of the system.

Table 1. Analysis of the generation and coupling mechanism of public security risks under peak passenger flow in Harbin

Risk Category	Specific Manifestations and Transmission Paths	Main Vulnerability Dimensions	Explanation of Risk Coupling Effect
Risk of Dense Crowds in Core Scenic Areas	Instantaneous ultra-high density crowds in limited spaces of core scenic spots such as Harbin Ice-Snow World and Central Street, exceeding the design capacity, directly leading to a surge in stampede risks.	Physical Vulnerability (spatial capacity limit) Social Vulnerability (crowd management capacity)	The most direct and prominent primary risk.
Risk of Urban Transportation System Pressure	The influx of a large number of self-driving tourists and "high-speed rail tourists" leads to: Severe congestion on main roads and transportation hubs → increased probability of accidents. Emergency rescue channels facing blockage → amplified harm of secondary disasters.	Physical Vulnerability (road network capacity threshold) Social Vulnerability (traffic dispatch and collaboration efficiency)	The risk is network-transmissive, prone to causing systemic paralysis, restricting rescue response, and strongly coupling with other risks.

Risk of Derived Safety Accidents	The surge in passenger flow overloads associated systems: Reception facilities (accommodation, catering) → increased risks of fire, food safety, and public security. Infrastructure (power supply, water supply, communication) → prominent failure risks.	Social Vulnerability (industry supervision coverage) Physical Vulnerability (infrastructure aging and redundancy)	Risk points are scattered and hidden, spreading from core areas to the surrounding areas, forming the possibility of a chain reaction like "a fire spreading from camp to camp."
Risk of Extreme Weather Superposition	Inherent extreme weather (such as low temperature, cold wave, heavy snow) in the ice and snow tourism season, when superimposed with peak passenger flow, sharply amplifies: Personal injury risks such as slips and frostbite. Traffic disruption risks.	Environmental Vulnerability (regional climatic conditions) Physical Vulnerability (system pressure resistance elasticity)	As a "threat multiplier," it has a coupling effect with the above three types of risks, significantly increasing their possibility and harmfulness.

Comprehensive assessment shows that the public security challenges faced by Harbin are not a simple superposition of isolated risks, but a complex system with intertwined elements and dynamic evolution. Specifically, its risk structure presents the following three typical characteristics:

3.1. Systemicity and Cascading Transmission of Risks

Various risks constitute a highly interconnected network structure and trigger cascading effects through "risk chains." For example, extreme weather (environmental vulnerability) will exacerbate traffic congestion (physical vulnerability), and the paralyzed transportation network will hinder emergency rescue, thereby amplifying the serious consequences of scenic stampede risks (physical/social vulnerability) or derived accidents. This non-linear and cross-domain transmission mechanism means that any local vulnerable point may evolve into an inducement for systemic collapse.

3.2. Superposition and Resonance Amplification of Vulnerabilities

The ultimate formation of risks stems from the multiple superposition of external shocks and internal vulnerabilities. Among them, social vulnerability (such as blocked cross-departmental collaboration and insufficient information sharing) acts as a "soft constraint," which will significantly amplify the negative impacts brought by physical vulnerability (infrastructure overload) and environmental vulnerability (extreme climate), becoming a structural bottleneck restricting the overall adaptation and recovery capacity of the system.

3.3. Marginal Diminution of Governance Capacity and System Failure

Under the continuous pressure of peak passenger flow, the emergency management model relying on a single department and traditional means shows obvious marginal effect diminution. For example, merely dispatching more police to core scenic spots without coordination with measures such as traffic diversion and public information guidance will result in extremely limited overall governance efficiency. This indicates that locally optimized governance strategies are inevitably destined to fail in the face of systemic risks, and it is necessary to promote the transformation of the governance model from fragmented response to holistic and forward-looking resilience governance. Resilience governance emphasizes the formation of an integrated governance framework by the various elements of the governance system. This framework enables the reshaping of the relationship between vulnerable entities and risky environments through self-adaptation, ultimately achieving the transformation of governance functions via adjustment and evolution [5].

4. Dual presentation of vulnerability and resilience: an evaluation of the effectiveness of the early warning mechanism in responding to peak passenger flow

4.1. Initial resilience of agile perception and systemic obstruction in data collaboration

In the links of information collection and risk assessment, Harbin's early warning mechanism has initially demonstrated the adaptive characteristics of "digital intelligence empowerment." Specifically, it is reflected in the attempt to integrate multi-source big data such as air ticket and hotel bookings, social media popularity, navigation App data, and mobile phone signaling, marking a transformation of risk perception methods from relying on static and lagging data to dynamic, diverse, and real-time perception. This transformation has laid the foundation for constructing a forward-looking and three-dimensional passenger flow

risk profile, reflecting the system's initial ability to actively acquire information and identify changes in complex scenarios. However, alongside the above resilience characteristics, there are in-depth systemic obstructions.

Firstly, the system's prediction of the behavioral patterns and scale of "non-traditional" source tourists (such as self-driving tourists from southern China) is obviously insufficient. This is not a simple data deviation, but a profound reflection of the lag in the identification and learning mechanism of the government departments as the management subject regarding the behavioral changes of emerging "adaptive subjects" in the system. The mobility and decision-making dispersion of self-driving tourist groups pose a fundamental challenge to the prediction system based on fixed hubs and historical models. Secondly, the data barriers between key departments such as culture and tourism, transportation, and public security remain solid, and the phenomenon of "information silos" is prominent. Essentially, this is a systemic obstruction caused by the division of powers and responsibilities under the bureaucratic system, the concept of data sovereignty, and the lack of top-level sharing mechanisms, which hinders effective information interaction between different subjects and makes it difficult to achieve global and panoramic risk assessment. For example, if real-time traffic flow cannot be cross-referenced with cultural and tourism reservation data, it is difficult to accurately predict the congestion risk in local areas. Thirdly, the system's sensitivity to derived risks "emerged" from the non-linear interaction of micro-subjects (such as instantaneous gatherings in back streets and alleys, and fire hazards) is insufficient. This indicates that its monitoring network still focuses on macro and traditional risk points, and faces severe challenges in terms of grid-based, refined, and forward-looking risk assessment.

4.2. Initial resilience of channel expansion and expression innovation and in-depth obstruction in information effectiveness

In the link of early warning information release, the mechanism has shown adaptive efforts in channel diversification and expression affinity. Channel construction has expanded from traditional media to platforms such as government affairs new media and commercial map Apps, initially forming a three-dimensional communication network complementary to official and commercial channels, enhancing the breadth of information reach. In terms of expression, it has taken the initiative to adopt internet discourses such as "little potatoes" to improve the affinity and acceptance among young tourists, reflecting the system's style adjustment to adapt to heterogeneous tourist groups. However, the overall effectiveness of its information transmission still faces in-depth obstructions.

The primary problem lies in the lack of inherent value of information. Most early warning content stays at macro descriptions such as "large passenger flow," lacking decision-supporting information such as specific locations, quantitative data, consequence predictions, and alternative plans, which cannot effectively guide the distribution and behavioral optimization of tourists, making it difficult to achieve advanced risk mitigation. Secondly, the system has significant vulnerabilities in cross-channel collaboration and precise reach. The lack of synchronization and consistency of information across different release platforms is likely to cause public confusion and weaken early warning authority. More fundamentally, the system has failed to accurately identify and adapt to the information reception habits of tourists as "differentiated adaptive subjects," and there are blind spots in the coverage of key information for "digitally vulnerable groups" such as foreign tourists and the elderly, exposing its structural shortcomings in refined and differentiated service capabilities, and ultimately leading to the attenuation of early warning signal effectiveness at the transmission end.

4.3. Resilient performance of partial collaboration and in-depth disconnection in systemic linkage

In the linkage of early warning and response, the mechanism has demonstrated basic collaborative capabilities under normal or local high-pressure scenarios. For example, in response to holiday peaks, multiple subjects such as traffic management, subway, public security, and volunteers can launch temporary traffic control, free shuttle services, and pre-positioned services such as "spoiling tourists," reflecting the initial response and collaborative awareness of the system in preset scenarios after early warning triggering. The rapid public relations and service recovery after the ticket refund incident at Harbin Ice-Snow World also reflect the basic emergency capabilities of the operation end under public opinion pressure. However, its linkage mechanism shows significant insufficient adaptability when facing global and extreme peak pressure.

Firstly, there are obvious "institutional gaps" and "response delays" in cross-departmental collaboration, exposing that the internal system still adheres to bureaucratic processes under normal conditions and has not established a networked collaborative evolution mechanism for complex crises. The division of powers and responsibilities between vertical and horizontal departments makes it difficult to efficiently integrate resources and information under emergency conditions. Secondly, "circuit breaker decisions" under extreme scenarios—such as suspending ticket sales and closing core entrances—often show hesitation and delay, reflecting the system's trade-off dilemma among multiple goals such as safety, economy, and public opinion, as well as the lack of rigidity in the implementation of the "safety first" principle. A deeper problem is that existing emergency plans generally lack clear trigger thresholds and standardized operating procedures based on dynamic data, leading to responses that are highly dependent on on-the-spot decisions and subjective experience rather than objective instructions. This indicates that the

system has not yet formed self-organizing adaptive rules, and its linkage effectiveness is still based on fragile human coordination, making it difficult to cope with highly uncertain peak impacts.

5. Discussion and implications: a holistic framework for optimizing the resilient early warning mechanism

5.1. Promote Technological Empowerment: Systemic Upgrading from Data Integration to Intelligent Analysis

At the technical level, the core of optimization lies in promoting the early warning mechanism from the application of scattered information tools to the leap of systematic and intelligent governance capabilities. The key is to build a city-level comprehensive governance platform for passenger flow risks, whose core mission is to completely break down data barriers between systems such as culture and tourism, transportation, and public security, and form a "command center map" for global perception by integrating multi-source real-time data, equipping the public security system with an efficient and collaborative "digital brain." This platform should not only realize the visualization of data but also deeply integrate big data simulation and artificial intelligence algorithms to achieve forward-looking prediction of the temporal and spatial distribution of passenger flow and simulation deduction of different plans. This marks a fundamental transformation of the early warning logic: from passive "prediction" relying on historical laws to active "forecast" and "preview" facing multiple future scenarios, thereby greatly enhancing the system's situational awareness and strategy generation capabilities for complex risks. At the same time, the front-end perception network should be systematically deployed and upgraded. Deploy intelligent cameras, IoT sensing devices, and other equipment densely at key nodes such as core scenic spots and transportation hubs to build a highly sensitive urban perception nerve ending. This network aims to capture real-time micro-level passenger flow density, distribution dynamics, and abnormal signals, converting the originally invisible local risk "emergence" phenomena into quantifiable and early warning data indicators, fundamentally making up for the shortcomings of the existing system in refined monitoring and providing underlying support for the precision of early warning and response.

5.2. Reshape Interaction Rules: Mechanism Innovation from Bureaucratic Collaboration to Coupled Linkage

At the management level, the core of optimization lies in reshaping the interaction mode of subjects within the system and promoting the emergency mechanism from formal bureaucratic collaboration to substantive networked coupling. The primary measure is to establish an "integration of peacetime and emergency management" joint command structure, systematically optimize the interaction rules among key subjects by setting up a regular peak passenger flow emergency command center and solidifying standard processes for cross-departmental collaborative operations. This initiative aims to transform temporary and mobilized mechanical collaboration into institutionalized and embedded organic integration, thereby significantly reducing collaborative friction and improving overall response efficiency. On this basis, efforts should be made to promote the digital and automated upgrading of emergency plans, transforming coarse-grained text plans into refined and executable instructions embedded with dynamic data trigger conditions. Essentially, this is to set clear adaptive rules for complex systems, and by shortening the decision-making chain and reducing excessive reliance on individual experience, enable the system to launch efficient "self-organizing" responses under specific risk thresholds, enhancing its structural resilience in uncertain scenarios. Furthermore, a comprehensive "grid-based" resilient governance unit can be constructed, decomposing the macro urban system into several micro-management grids according to space or function. By delegating management authority and resource allocation to the grid level, early risk detection, accurate resource delivery, and strong responsibility implementation are achieved. In essence, this strategy converts overall complexity into local controllability through the reorganization of system structure, which is a key mechanism arrangement to improve system adaptability and reduce global vulnerability.

5.3. Cultivate Adaptive Subjects: Build a Multi-Center Collaborative Social Resilience Network

On the social path, the core lies in reshaping the relationship between the government and society, and building a distributed and self-organizing public security governance ecosystem by cultivating multiple subjects with risk adaptation capabilities. The primary task is to systematically improve the public's risk literacy and self-adaptive capacity, transforming tourists and citizens from passive management objects into active actors mastering risk identification, avoidance, and mutual rescue skills through innovative risk communication and emergency popularization. This transformation not only directly reduces individual risk exposure but also enhances the overall resilience foundation of the social system at the micro level. On this basis, efforts should be made to build an institutionalized multi-subject collaborative network, systematically incorporating travel agencies, online platforms, transportation operators, merchants, and social organizations into the early warning dissemination and emergency response processes. This is not a simple functional expansion, but the cultivation of a distributed action system in line with the principle of "multi-center governance" by establishing clear power and responsibility rules and interaction interfaces. This

network can effectively share the pressure on the government and significantly enhance the overall capacity and adaptive diversity of the system to cope with uncertainty through functional complementarity and resource redundancy among subjects. In addition, it is necessary to build a social consensus of "safety first" through continuous and transparent communication. This soft governance element is crucial. It constructs a rational public opinion environment and social recognition for necessary risk intervention measures (such as passenger flow circuit breakers), which can significantly reduce social friction during the implementation of key decisions and provide solid social support for adaptive adjustments to fundamentally maintain public security.

6. Conclusion

Taking Harbin's ice and snow tourism as a typical case, this paper systematically examines the structural characteristics and operational logic of urban public security early warning mechanisms under peak passenger flow scenarios by constructing an analytical framework integrating "mechanism resilience" and "systemic vulnerability." The research shows that the urban public security system is essentially a complex adaptive system, and its performance under extreme pressure depends not only on the intensity of external shocks but also on the distribution of internal vulnerabilities and the adaptive capacity among subjects. Harbin's practice further reveals that the resilience level of the early warning mechanism is not generated in isolation, but is the result of the complex coupling among social vulnerability (such as collaborative obstruction and information silos), environmental vulnerability (such as extreme weather), and physical vulnerability (such as facility overload). Therefore, the fundamental path to improving system resilience lies in accurately identifying and weakening key vulnerable nodes through systematic intervention, while strengthening the self-adaptation and collaborative capabilities of multiple subjects in a dynamic environment.

At the theoretical level, by integrating vulnerability theory (commonly used for static structural analysis) and resilience theory (focusing on dynamic processes), this paper provides a new perspective for understanding the behavioral mechanisms of complex adaptive systems under pressure: resilience is the external manifestation of system behavior, while vulnerability is its inherent structural root. This integrated perspective not only expands the theoretical tools of public security research but also promotes emergency management research from phenomenological description to mechanistic diagnosis and from static control thinking to dynamic governance logic.

At the practical level, this study not only provides specific optimization directions for Harbin and other tourist cities facing peak passenger flow challenges but also refines universally significant governance implications: urban public security management must shift from the traditional "predict-response" paradigm to a more flexible and learning-oriented "perception-adaptation" paradigm. In the future, efforts should be made in coordination from three dimensions: technology, institutions, and society. By building an intelligent hub to enhance system "wisdom," reshaping subject "rules" through mechanism innovation, and activating governance "potential" through social participation, a new pattern of urban governance that not only adheres to the bottom line of safety but also supports high-quality development can be constructed in the public security landscape intertwined with uncertainty and complexity.

References

[1] Wang, J. (2009). Emergency management reader. Central Party School Press. p. 102. (Original work published in Chinese)

[2] Zheng, G., Zhong, S., & Liao, Z. (2025). How to build a more resilient grassroots public safety governance network? A case study of D Subdistrict. *Chinese Public Administration*, (9), 131–144. (Original work published in Chinese)

[3] Yang, H., Chen, Z., et al. (2025). Research on the data security risk assessment system in the transportation industry. *Information Security Research*, (11), 90–98. (Original work published in Chinese)

[4] Zhou, F. (2025). The internal mechanism and practical path of digital-intelligence enabled risk-resilience governance in urban communities. *Journal of Guangzhou University (Social Science Edition)*, (5), 138–148. (Original work published in Chinese)

[5] Li, W., & Yao, T. (2025). The practical logic and enhancement path of urban community resilience governance: An analytical framework based on “structure–tools–capacity.” *Journal of Social Science of Hunan Normal University*, (3), 50–59. (Original work published in Chinese)