

Article

Disaster Emergency Resources Management Improvement Plan in China- Shandong Province

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Abstract: Disaster emergency resources reserves play an important role in ensuring the stable development of the economy and society and are directly related to the country's overall development plan. The outbreak of the COVID-19 pandemic has not only affected the daily order of society, but also put a test on our ability to deal with emergencies, which further highlights the importance of disaster emergency resources reserves. This paper takes Shandong Province as an example to discuss the current situation of emergency resources reserve management in this province, and introduces its basic situation, division of management responsibilities and procurement and storage allocation system. At the same time, combined with the actual situation in Shandong Province, the existing problems were analyzed, mainly including imperfect management system, shortage of reserve structure, lack of professional talents, lack of management supervision, and insufficient rotation of emergency resources reserves. The main causes of these problems include insufficient awareness of emergency resources reserve management, unreasonable formulation of emergency resources reserve plans, imperfect talent system, insufficient guarantee of relevant legal systems, and low rotation management capabilities. Aiming at the existing problems, this paper puts forward a series of suggestions, mainly related to the optimization of the emergency resources reserve management system, the optimization of the reserve management framework, the improvement of infrastructure construction, the improvement of the personnel training system, the strengthening of the legal system, and the rotation of emergency resources reserves. improvement and the establishment of a performance evaluation system.

Keywords: Disaster; Emergency Supplies; Resource Reserve Management; Improvement Plan

1. Introduction

1.1. Background and Objective of the Research

The future is an era of uncertainty. A society of the future recognizes the fundamental limitations of information in providing certainty about what lies ahead. Humanity can be seen as progressing and evolving through its efforts to overcome uncertainty [1]. Disasters have been accompanying humanity from its inception to the present day. Natural disasters such as typhoons, earthquakes, floods, heavy snowfall, and drought, as well as social disasters including fires, building collapses, explosions, traffic accidents, air pollution, and chemical accidents, constantly occur, resulting in loss of life and economic damage [2]. As society and economy continue to progress and prosper, the occurrence of various disasters poses a significant threat to a nation's economic and social development. Simultaneously, they have the potential to disrupt societal stability and harmony.

The management of emergency supplies stockpiling is a critical task with significant importance in preventing loss of life and property resulting from natural disasters and

accidents. Providing timely and effective rescue and support in the event of sudden incidents requires adequate preparation and stockpiling of various materials. Therefore, the government's recognition of the importance of emergency management and the efficient management of emergency supplies stockpiles is an essential expression of its capacity to prepare for unforeseen disasters.

Compared to other countries, China started emergency relief supplies stockpiling management relatively late. It was only at the end of the last century that China announced and implemented its first system for stockpiling disaster relief supplies [3]. The implementation of this system signifies that China's disaster relief supplies stockpiling system has gradually improved. In early 2020, the outbreak of COVID-19 presented high demands for emergency relief supplies. However, during the initial phase of the pandemic, there were some shortages in stockpiling and supply of medical materials, indicating ongoing challenges in China's emergency supplies stockpiling. Therefore, this epidemic has also urged the strengthening of the management level of emergency supplies stockpiling to ensure stable economic and social development.

The aim of this study is to establish a scientific and rational structure for emergency supplies stockpiling. A scientific and rational structure for emergency supplies stockpiling enables effective handling of emergency incidents, minimizes disaster losses, and ensures continuous supply of emergency materials [4]. Secondly, to establish an effective emergency management system in complex and diverse environments. Particularly, given that the situation surrounding the outbreak of COVID-19 is still ongoing, and the response to sudden public incidents has gradually become normalized, it is crucial to keep up with the level of management in emergency supplies stockpiling. Taking this opportunity, the continuous improvement of emergency supplies stockpiling management for incidents stemming from public hygiene issues should be pursued. By doing so, the demands necessary for national development can be met, and the safety of the public's lives and properties can be effectively ensured. Thirdly, to further enhance the level of emergency supplies stockpiling management in Shandong Province. Currently, Shandong Province is in a high-quality stage of economic development and must ensure stable economic growth while maintaining the quality of development and ensuring the safety of people's lives and production. To achieve this, it is important to continuously acquire and learn from relevant experiences in advanced countries and regions. Through such experiences, the management system should be continuously optimized, and the capacity for risk resistance should be improved. This will not only enhance disaster prevention capabilities but also provide references and guidance for other provinces.

1.2. Research Scope and Methodology

This paper provides an in-depth discussion on improving the management of emergency supplies stockpiling, with a focus on Shandong Province. It analyzes and summarizes the issues related to disaster emergency supplies stockpiling management, proposes improvement measures, and explores methods to enhance the scientificity and efficiency of disaster emergency supplies stockpiling management. It also provides references for disaster and emergency operations in Shandong Province and other regions.

To achieve this objective, various research methods such as interviews, case analysis, and literature review are employed to conduct comprehensive and systematic analysis and evaluation of the current status, issues, and influencing factors of disaster emergency supplies stockpiling management. Based on this analysis, a series of improvement measures are proposed with the aim of enhancing the efficiency and accuracy of emergency supplies stockpiling management in Shandong Province, as well as improving the emergency response capabilities and standards to provide strong assurance for post-disaster recovery and reconstruction. Interviews serve as a powerful tool for exploring complex social phenomena and understanding individuals' perspectives. Simultaneously, interviews serve as the most important research method in this study. By utilizing various

approaches such as interviews and survey research, an understanding of the responsibilities of each department in Shandong Province and the overall operational practices was gained. An analysis of the related issues arising in the current process of emergency supplies stockpiling management in Shandong Province was conducted. To address the issues related to emergency supplies management in Shandong Province, departments such as the Shandong Province Food and Material Stockpiling Bureau, Shandong Province Health and Hygiene Committee, and Shandong Province Emergency Management Agency were investigated. Through this investigation, issues concerning system reforms, improvement of management mechanisms, and construction of stockpiling warehouses were examined. Additionally, by identifying the overall situation and areas of deficiencies in Shandong Province, a robust foundation was established for the smooth development of the research paper.

2. Theoretical Background

2.1. *The Significance of Disaster Management*

Disaster management is defined as the collective term for activities that encompass all phases of mitigation, preparedness, response, and recovery. It involves managing various disaster situations and encompasses the development and implementation of policies related to mitigation, preparedness, response, and recovery to minimize the impact of disasters [5]. Disaster management is an activity that encompasses all aspects of both pre-disaster and post-disaster phases. Disasters possess characteristics such as uncertainty, complexity, and interactivity, and disaster management involves managing these characteristics [6]. The most important aspect of disaster management is establishing a system that recognizes and prevents situations before a disaster occurs. The better the prevention measures are in place, the more effectively damages can be minimized when a disaster strikes. Therefore, it is crucial to dedicate sufficient effort to identify potential disasters and prepare response strategies using scientific and effective methods [7].

The mitigation phase can be defined as the activity of determining what needs to be done in places where there are risks threatening human life, property, health, safety, and well-being. The preventive phase encompasses two main aspects. Firstly, it involves preventive measures to avoid the occurrence of a crisis. Secondly, it encompasses mitigation measures to minimize the damages caused by a crisis. In this context, the preventive phase entails implementing plans to prevent the occurrence of a crisis, executing strategies to reduce the scale of damages resulting from a crisis, and undertaking activities aimed at reducing the long-term risks to human life and property posed by various crises [8].

The preparedness phase refers to taking actions, including planning and preparation for disasters, before being affected by them. The inevitability of disaster occurrence highlights the critical role of disaster preparedness in organizational survival. Therefore, it is becoming increasingly important to seek effective preparedness measures for disasters. While disaster preparedness strategies cannot eliminate all risks, they have enhanced the capacity to respond to external shocks. However, unprepared citizens will become more reliant on emergency services and non-governmental organizations for their survival [9].

Disaster response involves taking actions during the immediate and short-term period following a disaster to address the urgent needs of affected individuals, minimize casualties, and mitigate further damage [10]. Typically, the initial phase of disaster response focuses on life-saving interventions and preventing additional property loss, with a primary emphasis on providing basic humanitarian support to affected individuals [11].

Disaster recovery refers to the phase following the containment of a disaster incident, where emergency managers strive to restore social property, infrastructure, social order, and societal well-being [12]. The process of disaster recovery includes measures such as ensuring the safety and well-being of affected populations, restoring and rebuilding damaged properties, and revitalizing social and economic activities within the affected community [13].

2.2. *Types of emergency supplies*

Emergency supplies refer to the materials that must be provided and readily available to promptly and appropriately support the affected population in the event of significant natural disasters or sudden public emergencies [14]. Currently, emergency supplies are commonly classified using three general methods.

Firstly, emergency supplies are classified according to the type of incident. Each incident requires specific types of emergency supplies. Major incident types include natural disasters, public health incidents, accidents and disasters, economic security incidents, and social security incidents. The required types of emergency supplies vary depending on the incident type.

Secondly, emergency supplies are classified based on their scope of use. They can be categorized into two different types: general-purpose and specialized supplies. General-purpose supplies refer to emergency materials that can be applied to most situations after a sudden incident occurs. These materials may include basic necessities such as water, medicine, and food. Specialized supplies, on the other hand, are allocated based on specific events or for specific demands. Examples include medical supplies and vaccines, which are dedicated resources used for specific purposes in emergency situations [15].

Thirdly, emergency supplies are classified according to the urgency of the emergency situation. The urgency and timing of demand for emergency supplies can vary after a sudden event occurs. This classification can be further divided into three levels: general, severe, and urgent [16]. This classification helps determine the prioritization and response strategies for emergency supplies.

2.3. *Emergency Supply Stockpiling System*

2.3.1. *Emergency Supply Source*

Emergency Supply Stockpiling System in China considers three key aspects to ensure the provision of necessary emergency supplies in response to sudden events. Firstly, there are stockpiled materials at central and local emergency supply centers. These stockpiles are prepared specifically for urgent response to sudden events and include essential items such as tents and blankets. The materials stockpiled at these centers play a crucial role in emergency response. Secondly, there are donated materials received from international or domestic social organizations. These donations primarily focus on providing essential goods like food and clothing and are aimed at socially effective assistance, both within the country and internationally. The donated materials are mainly utilized for providing essential items for daily life. Thirdly, there are materials stockpiled by relevant executing agencies. These materials have specialized characteristics and are stockpiled according to the specific sectors responsible for their management. At the national stockpiling level, procurement is usually entrusted to ensure efficient stock management. These materials are used for purposes such as search and rescue of injured individuals, resettlement of displaced persons, and guaranteeing basic needs during emergencies [17].

2.3.2. *Emergency Supply Stockpiling Methods*

Emergency Supply Stockpiling Methods are primarily implemented through three different categories. Firstly, there is government stockpiling. Government stockpiling is used as a means to ensure the availability of critical emergency supplies in response to sudden disasters. This is done at both the central and local government levels. In the event of a major disaster, local government stockpiling centers are utilized as a priority, and if the supplies from local government stockpiles are insufficient, sourcing from the nearest region is undertaken [18].

The second aspect is corporate stockpiling. Corporate stockpiling involves the replenishment and distribution of essential emergency supplies through agreements with businesses. According to regulations in China, local governments at the district level or

above are required to establish agreements with relevant companies. The government confers the responsibility for supply replenishment and distribution to the companies through negotiation. This stockpiling approach assists the government in alleviating the burden of emergency relief supply stockpiling and has emerged as a new model for enhancing the capacity of emergency supply stockpiling in recent years.

The third aspect is the stockpiling of production capacity, which is another approach to emergency supply stockpiling. This approach involves companies retaining a portion of their production capacity in accordance with agreements between the government and relevant businesses. In the event that stockpiled supplies are insufficient to meet the demand during an emergency, the government may require production companies to manufacture the necessary emergency supplies. This approach helps address shortages of emergency supplies and overcome regional constraints.

2.4. Review of prior research studies

Zhu [19] argued that the current supply chain has become a crucial business form participating in global economic integration, division of labor, and collaboration. The stability and reliability of logistics activities within the supply chain have become key factors determining the success or failure of supply chain operations. Considering the importance of corporate supply chains from a business perspective, this analysis explores the significance of emergency logistics systems. It proposes the establishment of early warning mechanisms, coordination and integration, risk assessment, and other system developments based on both economic and non-economic factors.

Zhang [20] pointed out that the selection and placement design of emergency resources are critical issues in emergency system management. Depending on the characteristics of emergencies, appropriate site selection models are established, and the uncertainties, dynamics, and time constraints are analyzed. By formulating reliable plans for the selection and allocation of emergency service facilities, it provides a specific decision-making basis for emergency facility site selection.

According to a study by Kim Seung-Kwon [21], the duration victims can endure after a disaster is a minimum of three days, and relief supplies should be stored in warehouses designated for disaster preparedness. There are significant variations in the types and quantities of supplies among different regions, with some areas experiencing shortages in stock. It is challenging to ensure the availability of various supplies required at disaster-stricken areas and relief sites. Consequently, it is suggested that measures such as securing and stocking items in stages, differentiation based on age and gender, and implementing quality management approaches are necessary.

Park Cheon-Hee et al. [22] conducted a study on disaster relief supplies in Japan and the United States. They proposed that considering the situation and specificity of refugees, a wide variety of supplies should be prepared, and citizens should be educated to stockpile relief items themselves. They pointed out that in Korea, military relief supplies are provided with the same items regardless of the type of disaster or the situation faced by refugees. Park Cheon-Hee et al. suggested setting criteria for providing supplies based on three types of disasters: infectious diseases, fires, and earthquakes.

Bae Cheon-Jik and his research team discovered the inefficiency of relief supplies stockpiling management systems within each administrative agency. Bae argued that the government should provide support for the total demand while allowing relief support agencies to operate, leveraging their expertise in the process.

Wu [23] conducted a comprehensive analysis of the necessity of regional cooperation in crisis response using the 4R model of emergency management. The analysis encompassed the aspects of prevention, preparedness, response, and recovery. According to the analysis, emergency management faced several challenges in crisis response. First, there was a lack of strong supervision. Second, there was an imbalance in the distribution of emergency resources. Third, there were issues with low levels of emergency decision-making.

Lengv[24] believes that to improve the emergency stockpiling system to meet the demands of the new era, it is essential to strengthen regulations and system development for emergency stockpiling. Based on the "People's Republic of China Emergency Response Law," there should be a subdivision of classifications and the establishment of special legislation for various types of emergencies, such as floods, geological disasters, and infectious diseases. Measures for emergency stockpiling management should be established, and clear standards should be defined for the diverse processes of emergency material procurement, stockpiling, allocation, and recycling.

3. Issues and Causes

3.1. Issues

3.1.1. Insufficient Emergency Material Stockpiling Management System

In terms of emergency material stockpiling management system, there are notable issues related to fragmented stockpiling mechanisms, suboptimal resource utilization, and dispersion of resources. Additionally, certain materials suffer from duplication in storage, lack of data connectivity leading to resource waste, and shortages in stockpiling of specific items. For instance, items such as tents often remain unused and idle for extended periods after purchase. During the COVID-19 prevention and control process in 2020, sudden incidents caused rapid depletion of market supplies and severe resource shortages. There have also been situations where frontline workers faced shortages of winter clothing and insulation materials due to insufficient emergency material preparedness for natural disasters.

During the administrative system reform, there were instances of inadequate supervision resulting from the reforms themselves.

[Previously, the disaster emergency material management organization in Shandong Province was under the responsibility of the civil administration department. However, currently, it is managed by the food and material stockpiling department. However, unlike in the past, there are gaps in supervision between the civil administration department and the current department during cross-shift periods. This has resulted in difficulties in smooth handling of tasks related to material reception and coordination, causing challenges in carrying out our duties.] (Shandong Province Food and Material Stockpiling Department employee, 32 years old)

In recent years, in Shandong Province, efforts have been made to optimize the management system and improve the efficiency of emergency material stockpiling by dividing tasks and responsibilities among departments involved in the process. However, there are still challenges in cooperation and coordination among some departments, resulting in reduced efficiency in the management of emergency response material stockpiling.

[The food and material stockpiling department in Shandong Province is responsible for tasks such as purchasing and storing materials, as well as handling duties like material allocation based on emergency department and national requirements. However, there are instances where the expertise of different departments is not adequately considered, resulting in overlapping responsibilities between the specialized material stockpiling and emergency response material stockpiling departments.] (Shandong Province Food and Material Stockpiling Department employee, 32 years old)

In terms of information sharing and interconnectivity, there are also shortcomings in Shandong Province, where certain materials are consistently idle while others are constantly in short supply.

[In accordance with the latest national standards and relevant requirements, the emergency management department is responsible for flood and drought prevention, emergency rescue operations, and also includes material stockpiling. However, in actual operations, we have found issues of duplicate stockpiling of materials due to coordination with other departments, as well as a significant amount of materials reaching their expiration dates and wasting resources due to long-term repetitive stockpiling.] (Shandong Province Emergency Management Agency employee, 30 years old)

3.1.2. Structural shortage of emergency material stockpiling

First, there is a relative scarcity of stockpiling types. The National Development and Reform Commission classifies emergency materials into three categories, with hundreds of specific subcategories. However, in the case of Shandong Province, there is a problem of inadequate availability of specialized stockpiling warehouses to meet the demand. Especially during the early stages of the COVID-19 outbreak, there were widespread shortages of medical emergency materials such as masks and isolation suits in most regions, as well as supply issues with disinfectants and medical alcohol. This has made it difficult for production companies to procure and control emergency materials, leading to emergency situations regarding various types of materials.

[The emergency disaster reserve funds that our department currently manages include relatively limited types of stockpiles such as tents and protective clothing related to daily life. It is difficult to meet the sudden demand for emergency protection in the event of a sudden public safety incident.] (Employee B, 33 years old, Shandong Province Food and Material Reserve Department)

Secondly, the scale of stockpiling is insufficient. Although the amount of emergency supplies stockpiled in Shandong Province has increased in recent years, it is still lacking compared to other regions. Additionally, in terms of the construction of emergency supply warehouses, the storage area of Shandong Province's warehouses does not meet the national unified standards.

[According to relevant national regulations, the construction area of an urgent emergency stockpile warehouse should be between 6,000-8,000 square meters, and the total value of stockpiled materials should exceed 60 million yuan. However, in Shandong Province, the construction area of urgent stockpile warehouses is only 2,900 square meters, with a total value of stockpiled materials amounting to only 30 million yuan, which falls short of half the national standard.] (Employee B, 33 years old, from the Shandong Province Department of Food and Material Stockpiling)

The third issue is the single sourcing of emergency material stockpiling by contracted companies in Shandong Province. Typically, the stockpiling is carried out by awarded companies, and transitioning from a single company's stockpiling approach poses significant risks. Any issues such as contract violations or bankruptcy of the company can directly result in a shortage of emergency materials.

[I still believe that there are some remaining issues in terms of production capacity and stockpiling in Shandong Province. While many companies are responsible for emergency material production, there are also many companies that lack production capabilities and efficiency. Furthermore, our province has not experienced large-scale natural disasters for a long time, which raises doubts about the performance of contracted companies and their ability to meet the demands of our province in actual crisis situations.] (Employee C, 32 years old, Shandong Provincial Department of Food and Material Reserves)

3.1.3. *Lack of specialized personnel for emergency material stockpiling management*

Emergency material stockpiling management in Shandong Province involves a highly complex process, and specialized personnel are essential for its efficient execution. However, there is still an ongoing issue in Shandong Province regarding the shortage of personnel in the management sector and lack of specialized expertise. Despite personnel adjustments being made after institutional reforms, significant changes have not been achieved. While a new organization has been established to handle the procurement, storage, circulation, and day-to-day management of emergency stockpiles, it has failed to secure an adequate number of specialized personnel.

[The Rapid Disaster Relief Material Stockpiling Management Center has been transferred to our department from the Ministry of Civil Affairs after the institutional reforms, and the Rapid Grain and Oil Inspection Center under our department is responsible for its management. Although seven positions were added, only three official staff members were dispatched after its establishment, leading to the establishment of a dedicated material department responsible for stockpile management. A serious shortage of personnel has become evident.] (Employee A, 32 years old, of the Food and Material Stockpiling Department in Shandong Province)

[The Disaster Relief Material Stockpiling Management Center in Shandong Province is located under the Food and Oil Inspection Center of Shandong Province. It is responsible for supervising the central warehouse and six regional storage facilities for urgent purposes. However, due to the extensive workload of supervision, the existing workforce is facing challenges in meeting the demands of material management and disaster response tasks.] (Employee D, 34 years old, of the Food and Material Stockpiling Department in Shandong Province)

Shandong Province lacks a comprehensive and scientific plan for nurturing rational and skilled talents, particularly in terms of leadership positions and specialized technical personnel. In addition, the absence of specialized talents capable of dealing with various unforeseen situations and essential expertise in the production process is a significant problem.

[During the COVID-19 response process, Shandong Province experienced shortages in medical supplies. For instance, during the mask shortage, some companies urgently expanded their production lines. However, they failed to meet strict technical requirements, resulting in the production of products that did not meet the actual demand in terms of quality. Additionally, many other companies faced challenges in participating in mask production due to technological barriers and insufficient production capacity.] (Shandong Province Health and Hygiene Committee Employee A, 56 years old)

3.1.4. *Lack of management supervision in the process of emergency supplies stockpiling*

During the process of institutional reform, Shandong Province has not fully established a rich and comprehensive supervision system, laws, regulations, and systems for materials stockpiling. In reality, as institutional reform deepens, the lack of corresponding laws and institutional construction has resulted in certain inflexibility in the work. Furthermore, from the perspective of safety production and materials safety stockpiling supervision, the country has presented a general requirement that "all industries must ensure safety management," which has also had some impact on the functions and supervisory content of the materials stockpiling management department. However, there is still debate regarding whether the materials stockpiling management department should be

responsible for supervising the industrial operations of materials stockpiling-related companies or if the safety production supervision department should assume overall responsibility. Moreover, there are some flaws in the supervision of subsequent allocation and circulation of completed reserve materials. Currently, there are certain shortcomings in the legal supervision to ensure that the materials are in place and can be distributed 100% according to the actual situation, and the legal basis is not sufficient.

Secondly, there are difficulties in supervising corporate consensus stockpiling. In the case of physical material stockpiling, government departments can exercise supervisory authority to oversee the materials. However, in the case of corporate consensus stockpiling, the government and related companies have a contractual relationship based on agreed-upon terms, with the responsibility for material stockpiling and management primarily falling on the companies. In this process, the relationship between government departments and companies is one of mutual cooperation, and they work together collaboratively. In such a situation, the government cannot rely solely on administrative orders to ensure that companies strictly comply with government requirements. As a result, relevant government departments may lack sufficient understanding and awareness of actual stockpiled materials and need to rely on other law enforcement agencies to jointly conduct law enforcement inspections to ascertain the actual stockpiled materials. To some extent, government departments cannot fully guarantee the quality of stockpiled materials and emphasize the limitations of management constraints through contractual agreements.

3.1.5. Lack of rotation in emergency supplies stockpiling

Emergency supplies rotation refers to the process of regularly updating and dynamically circulating a portion of emergency supplies to ensure they are always maintained at optimal quality in order to meet the demands of emergency situations.

[Shandong Province lacks experience in emergency supplies rotation management, and it was not until 2021 that they began exploring the rotation of medical supplies. Currently, there are still significant deficiencies in emergency supplies rotation. Emergency supplies stockpiling is not only about procurement and storage but also entails the crucial aspect of supply rotation. To establish a modern and efficient emergency supplies management system, it is essential to effectively integrate all aspects of procurement, storage, and rotation of emergency supplies. In this regard, Shandong Province requires more effort and improvement.] (Shandong Province Emergency Management Agency, Staff Member C, 42 years old)

3.2. Causes

3.2.1. Lack of rotation in emergency supplies stockpiling

ShanDong Province failed to fully understand the importance of emergency supplies stockpiling management when faced with sudden public safety crises or major infectious diseases. The prime time for effective management of emergency supplies stockpiling was missed. In the process of development, ShanDong Province prioritized industrial advancement and neglected the proper management of emergency supplies stockpiling, resulting in insufficient effectiveness in its management. This reflects a lack of sufficient interest in emergency supplies stockpiling management and a relatively weak sense of responsibility, leading to a lack of clarity in the overall management system and confusion regarding the concept of stockpiling in many departments. Although clear guidelines regarding emergency supplies stockpiling have been provided after administrative reforms, including the content, relevant fields, and stockpiling methods, there is still a lack of accurate understanding due to the inadequate attention from some ministries and departments.

[I used to think that the primary mission of the Grain and Stockpiling Department in emergency supplies management was to handle stockpiled materials appropriately. When we received allocation requests from other departments or units, it was our department's responsibility to fulfill those demands. However, my perspective has changed now. I realize that our department not only needs to handle the accommodation of stockpiled materials effectively but also requires collaboration and coordination with other departments. I believe it is crucial for our department to cooperate and ensure proper implementation in response to allocation requests communicated by higher authorities.] (Director of the Food and Stockpiling Department, ShanDong Province, 46 years old)

[Personally, during the early stages of organizational reform, I didn't fully understand the division of roles among different departments and the specific changes resulting from the reform. I always thought that the Grain Department and Stockpiling Department operated under separate systems, and my focus was primarily on following rules and regulations and fulfilling tasks according to directives from higher authorities. However, I realize now that this mindset may have caused us to overlook our own responsibilities and duties. Looking back, it was a time when we should have carefully considered how our individual tasks and responsibilities were interconnected.] (Employee D, Food and Stockpiling Department, ShanDong Province, 34 years old)

[Before the outbreak of the coronavirus, I was unaware that both the National Health and Hygiene Committee and the ShanDong Provincial Health and Hygiene Committee were still responsible for emergency management tasks. Additionally, I used to think that medical supplies did not fall under the category of emergency materials.] (Employee B, ShanDong Provincial Health and Hygiene Committee, 57 years old)

It is true that during the interview process, doubts were raised about whether some employees accurately understand the actual demand for emergency supplies. This can be seen as a case highlighting the problem of lack of awareness regarding emergency supply management. The theory of emergency supply demand considers various requirements such as the type, quality, and quantity of materials needed in emergency situations. However, it is crucial to grasp and respond appropriately to these demands. It would be necessary to assess whether some employees currently have a sufficient understanding of this emergency supply demand.

3.2.2. Unreasonable emergency supply stockpiling plan

The importance of establishing material stockpiling plans in the emergency supply management process of Shandong Province is emphasized according to the theory of emergency supply chain. However, in the current situation, the planning process is not sufficiently standardized and faces numerous constraints and non-scientific aspects that need to be recognized.

[Our department still has shortcomings in the construction of emergency material stockpiling warehouses and the establishment of procurement plans. In particular, delays persist in the process of formulating procurement plans, and we are still adhering to previous practices without making necessary modifications and improvements in line with the latest standards.] (Employee B, 29 years old, of Shandong Emergency Management Agency)

3.2.3. Inadequate talent management system

Talent is the most crucial resource in industrial development, and a sound talent cultivation and assurance system plays a vital role in fulfilling the responsibilities of talents. However, in the field of emergency stockpile management in Shandong Province, there is a serious problem of talent shortage. This is due to an incomplete talent system and inadequate personnel, which result in a series of cascading issues in talent cultivation, employment, and promotion processes. These problems are having a negative impact on industrial development.

Firstly, the current situation in Shandong Province regarding the cultivation of specialized professionals in the field of emergency stockpile management is not ideal. More than 90 universities in Shandong Province do not offer relevant majors specifically dedicated to emergency stockpile management, and there is also a shortage of professors who specialize in this field. As a result, there is a lack of talent supply in the specialized area of emergency stockpile management, and the efficiency of stockpile management is compromised as only candidates from logistics, administration, and related disciplines are selected for talent recruitment.

Secondly, there is a lack of mechanisms for identifying specialized professionals. In order to effectively perform emergency stockpile management and ensure orderly operations, the support of specialized professionals is essential. These professionals play a critical role in the development and growth of emergency stockpile companies. However, due to a lack of specialized technical knowledge and evaluation mechanisms, it is challenging to secure appropriate specialized talent in this field.

[In the current emergency stockpile management process, there is a gradual development of technical standards and processes regarding warehouse access. Many individuals have implemented QR code scanning technology to manage warehouse entry and exit, and technological means have enabled online supervision. It is essential that only experts can truly and effectively utilize and manage such technology. However, many companies are currently not sufficiently attentive to these technological aspects and are outsourcing these tasks to retired employees or contracted personnel. This actually diminishes reliance on specialized professionals and hinders the adequate utilization of specialized technology and personnel for efficient emergency stockpile management. This can have a negative impact on the efficiency and safety of emergency stockpile management.] (Director of Food and Material Reserves, Shandong Province, 46 years old)

Thirdly, there is a lack of competitiveness in recruiting talents in the field of emergency materials stockpiling management. Furthermore, Shandong Province lacks a specialized incentive system to attract talents, which poses challenges in talent acquisition.

[Compared to major cities like Beijing, Shanghai, and Guangzhou, Shandong Province has a lower level of development, making it difficult to attract highly skilled professionals with overall competitive wages and benefits. Additionally, even if we manage to recruit high-level talents, many of them lack interest in emergency materials stockpiling management and tend to focus on other fields such as the internet, cutting-edge scientific research projects, and finance.] (Employee A, 30 years old, Shandong Emergency Management Agency)

3.2.4. Lack of legal framework and safeguards for emergency materials stockpiling

Firstly, there is a problem of outdated laws and systems related to emergency materials stockpiling management. Due to administrative reforms, some management authorities have undergone changes, leading to a weakened applicability of certain laws and regulations. As a result, the update of national management regulations and methods has been delayed.

「Some departments involved in emergency materials stockpiling management still face issues, as per the relevant national regulations, there should be a key management department under the National Economic and Trade Commission. However, during the process of administrative reform, this department was canceled, and a new management department has not yet been clearly established. 」 (ShanDong Province Health and Hygiene Committee Employee B, 57 years old)

Secondly, there is an issue with the lack of effective legal supervision mechanisms for emergency stockpile management. The laws and regulations are not being updated in a timely manner, resulting in loopholes and numerous compliance challenges during routine and industrial supervision processes. The supervision of emergency stockpiles is not adequately implemented, and the lack of timely updates to the legal system hinders the proper implementation of supervision mechanisms, creating legal gaps across the industry. This makes it difficult for companies to autonomously carry out various tasks.

「There are still significant issues in the management of health and medical supplies stockpiles, and the main reason appears to be the lack of clear regulations within the national legal framework, which has resulted in the inadequate formation of a proper mechanism. 」 (ShanDong Province Health and Hygiene Committee employee B, 57 years old)

3.2.5. Decreased circulation efficiency

Emergency material circulation varies depending on their respective characteristics. Different types of emergency materials are managed for specific purposes, with distinct procurement processes, stocking methods, and circulation regulations. All types of emergency materials have stocking periods and cycles, which pose challenges to the overall circulation of emergency materials. Some emergency materials may be stocked for extended periods without being utilized, while others have limited stockpiles and face difficulties meeting the demand in emergency situations.

「After the flood in Dongying City, Shandong Province, in early 2022, our Emergency Management Agency conducted a comprehensive investigation and assessment, which revealed issues in the circulation process of emergency materials in Dongying City. The maintenance and management of emergency materials were relatively delayed, and the system was insufficient, resulting in some delays in relief operations. Additionally, Dongying City has a relatively large-scale emergency material warehouse spanning 450 square meters, providing insights into the overall situation in other counties and cities. Currently, we are conducting investigations, analysis, and improvement efforts. 」 (Head of Sanitation and Health Commission, Shandong Province, 43 years old)

Table 1. The problem points and causes of emergency material reserve management in Shandong Province are sorted out.

	Issues	Causes
1	<ul style="list-style-type: none"> -There is a lack of horizontal collaboration or vertical communication. -The stockpiling mechanisms and resource utilization are not perfect. 	<ul style="list-style-type: none"> -There is a lack of importance given to the relevant departments. -The relevant staff did not fully understand their responsibilities.
2	<ul style="list-style-type: none"> -There is a relatively limited variety of stockpiling types. - The scale of stockpiling is small. 	<ul style="list-style-type: none"> -The planning process is not sufficiently standardized.

	-The stockpiling by collaborative enterprises is singular.	
3	-There is a lack of management personnel and specialized workforce. -There is a lack of rational and scientific talent development plans.	-The mechanism for developing specialized professionals in emergency stockpile management is inadequate. -The mechanism for identifying specialized professionals is insufficient. -There is a lack of competitiveness in talent recruitment. - There is a lack of performance evaluation.
4	-The supervision of stockpile management and related legal regulations are not perfect. -There are difficulties in supervising corporate consensus stockpiling.	-The legal framework for emergency supplies stockpile management is not being updated in a timely manner. -The legal supervision mechanism for emergency supplies stockpiling is not perfect.
5	-Insufficient circulation of emergency supplies stockpiling.	-The circulation of emergency supplies stockpiling varies depending on their respective characteristics. -The circulation efficiency of emergency supplies stockpiling is low.

4. Suggestions for improvement

First, in order to establish an efficient and organized emergency stockpile management system, it is necessary to improve inter-departmental understanding, enhance conceptual comprehension and establish clear directions. This can be achieved through administrative reform to strengthen collaborative relationships and establish mechanisms. Furthermore, it is important to demonstrate professional roles and supply capabilities in emergency situations, as well as exhibit the ability to coordinate and harmonize between departments [25]. China is pursuing a distinctive socialist market economy model, and this model should also be applied to emergency stockpiling. Emergency stockpiling is closely related to the management and operation of enterprises, and it relies on enterprises to meet the demand for emergency supplies. China's socialist market economy model has the advantage of minimizing risks associated with market uncertainties through the regulatory role of the government. Therefore, mutual understanding and coordination between the government and enterprises are crucial [26]. Enterprises should effectively prevent the risk of loss caused by market price fluctuations, actively participate in emergency stockpiling operations, and strengthen cooperation with the government. To achieve this, it is necessary to enhance the relationship between enterprises and the government by improving relevant provisions and standardizing their interactions.

Secondly, there are several issues in emergency stockpiling management in China. While administrative reforms have improved management efficiency, there is a lack of updates in laws and regulations, resulting in limited applicability. To address this, it is important to timely review and improve regulations and systems related to emergency response. Laws and regulations should be integrated as quickly as possible, and comprehensive regulations specific to emergency stockpiling should be formulated, taking into account local conditions. Clear rights and obligations of the government, enterprises, organizations, and individuals should be established, accompanied by legal support. Systemic reforms need to be deepened to enhance the standardization of emergency stockpiling management and provide robust support during emergencies. Additionally, con-

tinuous improvement and systematic operation should be strengthened to ensure compatibility with laws and regulations. Supervision and inspections should be conducted to verify the types and quality of emergency supplies and to implement updated legal regulations and systems [27]. The emergency stockpiling management department should comply with laws and regulations and maintain communication with other departments, striving for enhanced cooperation and collaboration. Through these efforts, effective supervision of emergency stockpiling management and reinforcement of regulatory compliance can be achieved.

Considering the current emergency stockpiling management structure in Shandong Province, it is necessary for us to actively expand the scope of stockpiling and raise the stockpiling grades. To achieve this, we need to strengthen the coordination with the overall emergency stockpiling inventory of Shandong Province. It is important to enhance the qualification assessment of companies, prepare various contingency catalogs, and ensure timely contract signing. Additionally, measures should be taken to ensure that contracted companies fulfill their responsibilities in terms of quality and quantity.

Thirdly, according to the theory of emergency materials demand, emergency stockpiling should meet the requirements in terms of types, quantities, and quality. Emergency materials management should aim to achieve the desired improvements, particularly in terms of effectively meeting the demand for emergency materials, especially in terms of quality [28]. The importance of emergency material warehouse construction is evident, and improvements are necessary to complement regional disparities and enhance the efficiency of emergency material management. It is crucial to adjust the demand and quality requirements based on the types of emergency materials and strengthen the construction of emergency material storage warehouses. Rapid implementation of standardized storage construction for emergency materials is essential, requiring collaboration with specialized design and infrastructure development. Scientific planning of warehouse construction plans at the regional level and setting targets based on population size are necessary. Additionally, close cooperation with health and other departments is vital to ensure that emergency material storage facilities meet health standards. These efforts will enhance the quality and efficiency of emergency material stockpiling in Shandong Province and enable rapid and effective response in emergency situations.

In modern society, intelligent and information technologies are widely utilized, and they should be actively adopted in the management of emergency material stockpiling. By leveraging artificial intelligence and big data analysis, we can predict and efficiently manage the demand for emergency materials. IoT technology enables real-time monitoring of inventory status in emergency material warehouses and facilitates timely replenishment. Cloud computing and mobile applications can be utilized for seamless real-time information sharing and effective response in emergency situations. The introduction of these intelligent and information technologies can significantly enhance the efficiency and responsiveness of emergency material stockpiling management.

Fourth, to enhance the level of emergency material stockpiling management, it is essential to have an adequate number of personnel and skilled professionals. Shandong Province needs to recruit specialized talents and strengthen their capabilities through education and training programs. By focusing on public safety and emergency management sectors, the demand for talents can be predicted, and specialized education programs can be implemented. Methods such as technical certification should be utilized to ensure quality and continuous talent acquisition. Additionally, it is necessary to innovate the education system and utilize university and various school platforms to enhance practical-based education and talent development, thereby improving comprehensive capabilities.

To maximize the role of emergency material management talents, it is crucial to not only increase the size of the workforce and provide effective training programs but also establish a scientific and systematic incentive mechanism. Actively recruiting and nurturing exceptional prospective talents and ensuring that their potential is unleashed through

incentives is vital. Relevant companies should improve talent incentive systems and regulations to promote the rational distribution of talents in areas such as capacity enhancement and warehouse management. Government departments need to create an environment conducive to attracting emergency material management experts and provide comprehensive and meticulous services to prevent talent outflow. Through these efforts, attracting more talents to the field of emergency material stockpiling management can be achieved, leading to robust emergency support.

Fifth, the expiration dates and management conditions of emergency materials vary depending on their types, and the emergency material management department should strengthen investigation and analysis to establish a regular circulation mechanism. Emergency medical supplies, in particular, have strict requirements for storage conditions and expiration dates, and compliance with these requirements is essential to prevent resource loss. In the process of stockpiling and circulating emergency materials, it is necessary to improve mechanisms and systems to strictly adhere to expiration dates and maintain freshness. Furthermore, systematic planning and management of emergency material supply and distribution should be carried out during disaster situations.

5. Conclusions

The purpose of this study is to identify factors influencing the management system of emergency material stockpiling during disasters and analyze their impact on the operational aspects of emergency material stockpiling management. Based on the actual emergency material stockpiling management in Shandong Province, this study combines interview data to describe the development blueprint of the stockpiling management system scientifically and reasonably from the perspectives of management structure, framework, infrastructure dimension, legal framework, talent development, circulation mechanism, and performance evaluation. Furthermore, constructive opinions and suggestions are provided to promote the high-level development of emergency material stockpiling management by addressing existing issues in the process. Currently, there is a relative lack of mature literature and research on the construction of a unified and efficient organizational structure for emergency material stockpiling management in the context of the new era. Particularly, it is known that the policy system from top to bottom is not sufficiently established in government documents. However, as continuous improvements in national information technology means and management experience are accumulated, it is expected that the comprehensive level of emergency material stockpiling management will also continue to improve. Through such development, maximum efficiency in emergency material stockpiling management can be achieved.

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