



“ENVIRONMENTAL HAZARDS IN ASIA – BUILDING RESILIENCE TO FUTURE HAZARDS”
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Enhancing the technical capacity and operational efficiency of state food reserve warehouses for building disaster resilience

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Abstract

State reserve commodities and materials are maintained to support emergency response, disaster relief, and urgent recovery operations in the event of major national emergencies, including natural disasters such as droughts, dzud, floods, and earthquakes, as well as large-scale industrial accidents and outbreaks of infectious diseases affecting humans and livestock. Their primary function is to ensure the timely delivery of essential supplies and emergency assistance while maintaining strategic stockpiles at the required types, quantities, and quality standards. In this context, there is an increasing need to introduce advanced warehouse technologies and modernize warehouse infrastructure and management systems to enhance operational readiness, improve storage efficiency, and ensure the reliability of state reserve resources during emergencies.

This study aims to assess the technical capacity and operational efficiency of Mongolia's state food reserve warehouses and identify opportunities for their improvement to strengthen disaster risk reduction. A mixed-method research approach was employed, incorporating document review, comparative analysis, questionnaire surveys, and technical-economic assessment.

The findings indicate that 96.0% of the surveyed warehouses are conventional storage facilities, while only 4.0% operate as semi-automated warehouses, with no fully automated facilities currently in use. Furthermore, 49.7% of the warehouses have been in operation for more than 41 years, demonstrating a high level of infrastructure aging. Compliance with warehouse construction standards reached only 36.0%, whereas compliance with food storage standards was 57.0%. Technical assessment revealed that the performance of temperature and humidity control systems was 49.9%, ventilation systems 39.0%, integrated information systems 42.0%, refrigeration equipment reliability 36.0%, and backup power supply availability 36.0%, indicating significant vulnerabilities in maintaining food quality and operational continuity during emergencies.

The economic evaluation showed that maintenance performance was relatively satisfactory (71.0%), whereas operational cost efficiency (40.0%) and food loss reduction performance (39.0%) remained insufficient. Survey respondents emphasized the urgent need for warehouse modernization, including equipment upgrades (100%), improvement of storage environments (96.6%), adoption of energy-efficient technologies (93.1%), and implementation of automation and digital warehouse management systems (89.7%).

The study concludes that introducing smart warehouse technologies, Internet of Things (IoT)-based environmental monitoring, automation, energy-efficient engineering solutions, and integrated digital logistics systems would substantially improve operational efficiency, reduce food losses, enhance the reliability of strategic food reserves, and strengthen Mongolia's national capacity for disaster risk reduction and emergency response.

Research objective and objectives

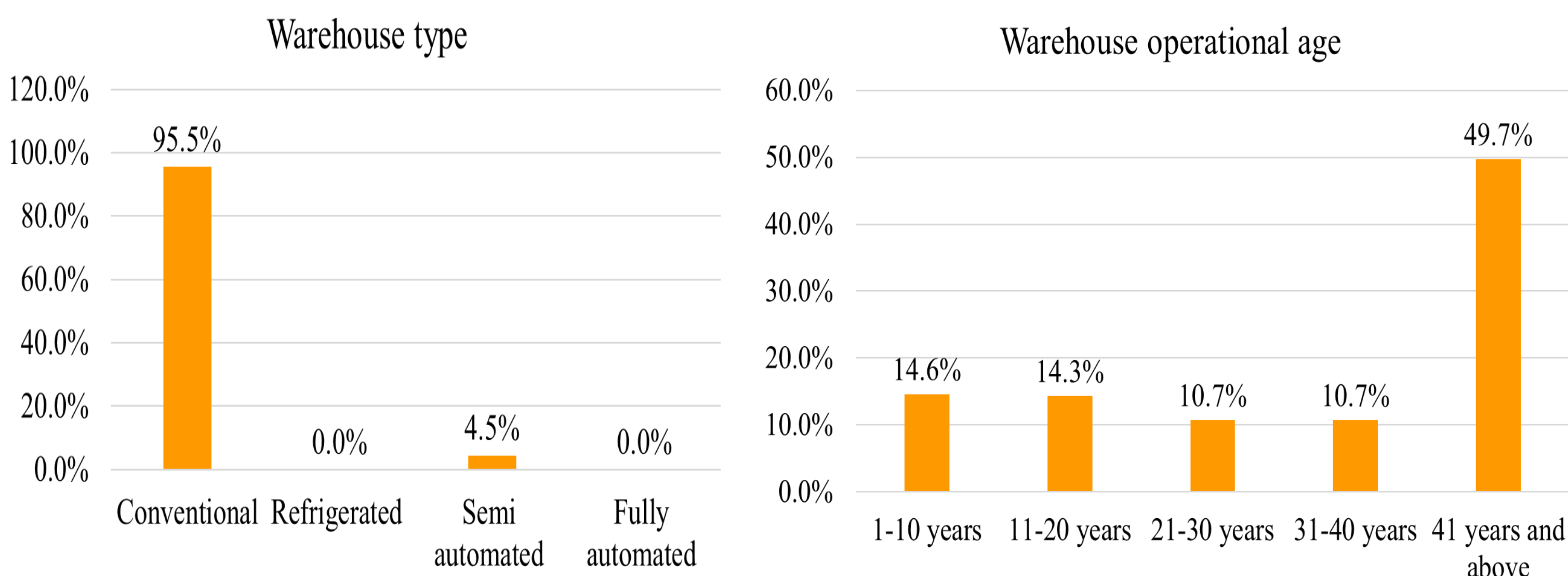
The objective of this study is to analyze the current technical infrastructure, technologies, storage conditions, operational efficiency, and economic performance of state reserve food warehouses, identify existing challenges and requirements, and explore opportunities for improvement through the adoption of modern technologies, automation, and energy-efficient solutions.

- To analyze the current status of the technical infrastructure, technologies, storage conditions, and operational practices of state reserve food warehouses.
- To identify challenges related to the economic efficiency, compliance with standards, human resources, and operational management of food warehouses.
- To develop recommendations for improving the operational efficiency, storage quality, and optimal utilization of state reserve food warehouses based on the research findings.

Results

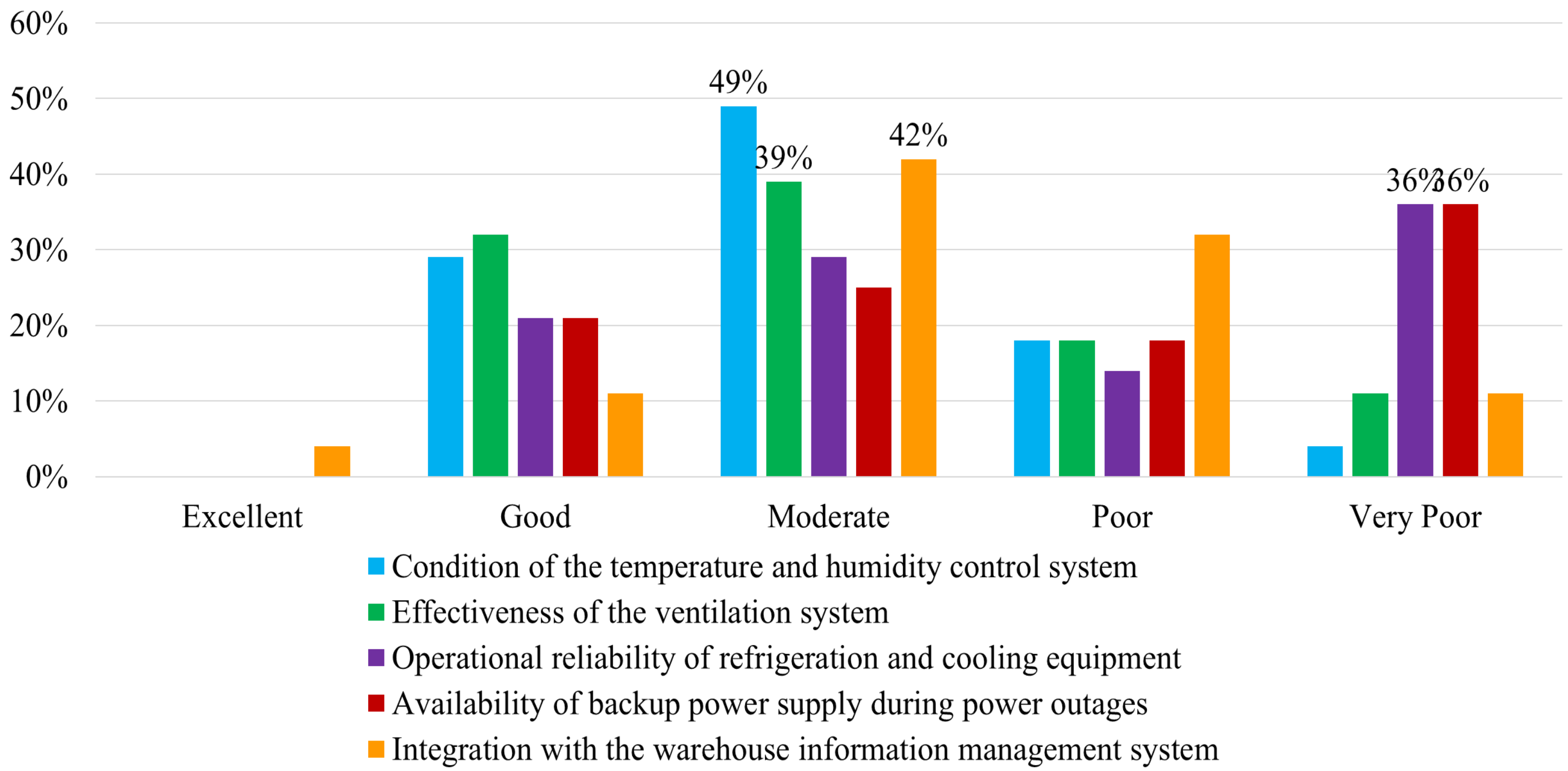
The results indicate that 96% of the state reserve food warehouses are conventional warehouses, while semi-automated warehouses account for only 4%. No refrigerated or fully automated warehouses were identified. In addition, 49.7% of the warehouses have been in operation for more than 41 years, whereas 28.9% and 21.4% have been in operation for 1–20 years and 21–40 years, respectively (Figure 1). These findings indicate that the majority of the warehouses have exceeded their optimal operational lifespan, highlighting the urgent need to modernize warehouse infrastructure, engineering systems, and storage technologies.

Figure.1 Types of food warehouses and their operational age



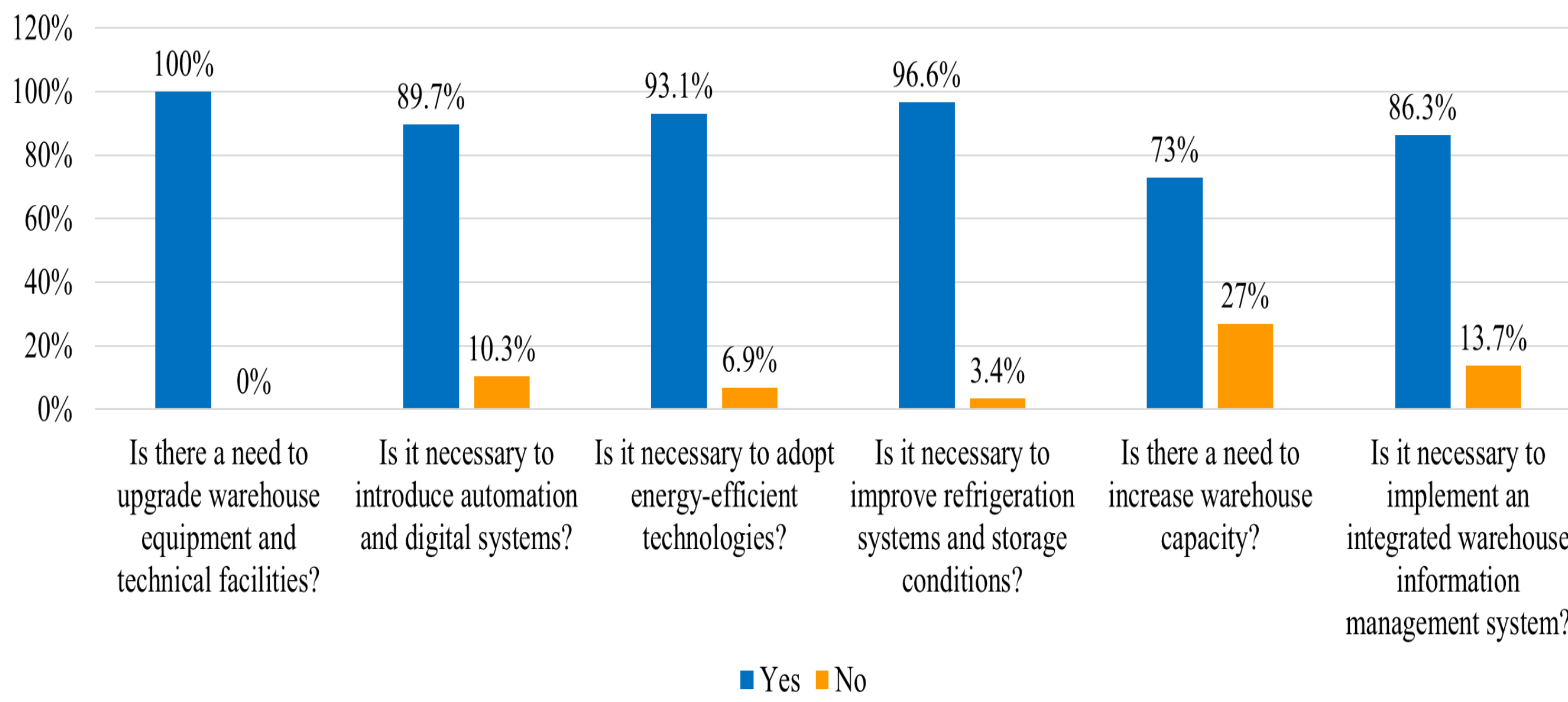
The results indicate that the temperature and humidity control system (49.9%), warehouse information management system (42%), and ventilation system (39%) received moderate ratings, suggesting that the basic storage conditions are generally maintained (Figure 2). However, these systems remain largely dependent on manual or semi-automated operations and have not yet reached the level of modern automated warehouse management. In contrast, the operational reliability of refrigeration equipment and the availability of backup power supply both received very poor ratings (36%), indicating inadequate refrigeration facilities and insufficient emergency power systems to ensure continuous warehouse operation.

Figure 2. Evaluation of temperature, humidity, ventilation, refrigeration, and power supply systems in food warehouses



The findings indicate a strong demand for the modernization of state reserve food warehouses (Figure 3). All respondents (100%) emphasized the need to upgrade warehouse equipment and technical facilities. In addition, 96.6% supported improving refrigeration systems and storage conditions, 93.1% recommended adopting energy-efficient technologies, 89.7% highlighted the need for automation and digital systems, 86.3% supported the implementation of an integrated warehouse information management system, and 73% emphasized the need to expand warehouse capacity. These findings demonstrate a high priority for modernizing warehouse infrastructure through technological upgrades, automation, and integrated information management systems.

Figure 3. Assessment of the need for improvement and modernization of state reserve food warehouses



Conclusion

- The results indicate that most state reserve food warehouses are conventional facilities, and nearly half have been in operation for more than 41 years, reflecting substantial aging of warehouse infrastructure and storage technologies. These findings highlight the urgent need for infrastructure modernization and capacity enhancement.
- Temperature, humidity, and ventilation systems achieved moderate ratings, whereas refrigeration equipment and backup power supply received the lowest ratings. These findings indicate the need for technological upgrades and automation to ensure reliable storage conditions and

continuous warehouse operation.

- Most respondents emphasized the need to modernize warehouse equipment, improve refrigeration systems, and implement automation, digital technologies, and integrated information management systems. These findings demonstrate a strong demand for the phased transition of state reserve food warehouses toward technology-driven and smart warehouse management systems.

References

- Government of Mongolia. (2020). Vision 2050: Long-Term Development Policy of Mongolia. Ulaanbaatar, Mongolia.
- Bottani, E., Casella, G., Nobili, G., & Tebaldi, L. (2022). Economic and environmental assessment of food cold chain logistics: An analytical modeling approach. Sustainable Production and Consumption, 30, 457–469.
- Chen, J., & Li, Q. (2023). Application of IoT, RFID and blockchain technologies in food cold chain logistics. Food Control, 145, 109487.
- World Bank. (2021). Cold Chains in Developing Economies: Opportunities for Reducing Food Losses and Improving Food Safety. Washington, DC: World Bank Group.
- Dash, P. (2021). State Reserves and Their Management [in Mongolian].
- Government of Mongolia. (2010). National Security Concept of Mongolia [in Mongolian].
- Ongoodoi, Ch., & Dolgorsuren, P. (2019). Commodity Science of State Reserve Goods [in Mongolian].
- Government of Mongolia. (2007). Law on State Reserves [in Mongolian].
- Government of Mongolia. Law on Ensuring the Safety of Food Products [in Mongolian].Government of Mongolia. (2012).