Logistica : Journal of Logistic and Transportation
E-ISSN: 3032-2766
Volume. 2, Issue 3, July 2024
Page No: 177-188

Humanitarian Logistics in Post-Disaster Response: Lessons from the 2018 Earthquake and Tsunami in Palu and Donggala

Andri Primadi[1], Sri Yanthy Yosepha[2]
[1]Institut Transportasi dan Logistik Trisakti, Indonesia
[2]Universitas Dirgantara Marsekal Suryadarma, Indonesia
Correspondent: andriprimadi_ok@yahoo.com[1]

Received : June 5, 2024
Accepted : July 21, 2024
Published : July 31, 2024

Citation: Primadi, A., Yosepha, S, Y. (2024). Humanitarian Logistics in Post-Disaster Response: Lessons from the 2018 Earthquake and Tsunami in Palu and Donggala. Logistica : Journal of Logistic and Transportation. 2(3), 177-188.

ABSTRACT: The increasing frequency of natural disasters highlights the importance of efficient humanitarian logistics in post-disaster response. This study examines the logistics challenges and adaptive responses during the 2018 earthquake and tsunami in Palu and Donggala, Indonesia. Interviews with 10 key stakeholders including national agencies, NGOs, military units, and local volunteers were analyzed using thematic analysis. Four themes emerged: infrastructure vulnerabilities, adaptive logistics strategies, multi-actor coordination, and system improvement. Findings show that damaged infrastructure and inconsistent survivor data significantly delayed aid distribution. However, adaptive responses such as drone mapping, logistics hubs, and helicopter drops mitigated accessibility barriers. Coordination improved in later phases through joint command posts and national logistics platforms. The study emphasizes the need for integrated logistics information systems and community-based preparedness to strengthen supply chain resilience. Limitations include the small sample size and localized scope, suggesting that future research should involve broader comparative studies across different disaster contexts. This research contributes to humanitarian logistics literature by providing grounded insights into the interplay of systemic risk, adaptive response, and governance in a complex disaster setting.

Keywords: Humanitarian Logistics, Disaster Response, Adaptive Logistics, Indonesia, Supply Chain Resilience.

INTRODUCTION

Indonesia is one of the most disaster-prone countries in the world due to its location at the intersection of major tectonic plates. This condition makes the archipelago highly vulnerable to earthquakes, tsunamis, volcanic eruptions, and hydrometeorological hazards. Such recurring events highlight the critical importance of post-disaster logistics management within the national disaster mitigation and recovery framework (1,2).

The 2018 Central Sulawesi earthquake and tsunami serve as a key case for understanding logistical failures and adaptive responses in large-scale disasters. The 7.4 magnitude earthquake triggered a tsunami and widespread liquefaction, causing over 2,100 deaths and massive infrastructure damage. Roads, bridges, and airports became inoperable, severely disrupting the delivery of emergency aid and personnel.

This disaster exposed critical weaknesses in Indonesia's logistical readiness, particularly in the first days of response. Failures in communication systems, fuel supply interruptions, and uncoordinated emergency centers compounded delays in aid delivery, demonstrating the urgent need for resilient logistics systems capable of functioning under extreme constraints (3,4).

The response, led by BNPB and supported by TNI, PMI, and international organizations such as IFRC and WFP, mobilized extensive resources. However, uneven distribution, redundant supply drops, and information bottlenecks persisted. Despite innovations such as mobile storage units and digital tracking systems, recurring challenges fragmented databases, limited inter-agency integration, and weak community involvement continue to hinder efficiency (5).

The economic impact of the disaster was equally profound, with losses estimated at over USD 1.3 billion. This figure includes damage to public infrastructure, private property, and disruption of productive economic sectors. Rapid assessment methodologies, such as the Global Rapid Post-Disaster Damage Estimation (GRADE), were implemented by the World Bank and GFDRR within the first week, underscoring the necessity for timely and evidence-based recovery planning.

Nonetheless, recurring issues in logistics operations post-disaster such as fragmented databases, lack of inter-agency integration, and inadequate community involvement continue to plague response efficiency. These issues point to the multidimensional nature of risk in humanitarian logistics, encompassing technical, institutional, and sociocultural domains (6,7).

Global frameworks such as the Sendai Framework for Disaster Risk Reduction (2015–2030) and IASC guidelines emphasize integrated, participatory approaches to logistics risk management. However, gaps remain at the local level, particularly in data interoperability and community capacity. Community-based strategies and indigenous knowledge remain underexplored but essential for building resilient logistics infrastructures (8). The Logistics Cluster under the UN OCHA and the Sphere Standards have also established operational benchmarks to guide humanitarian supply chains towards greater accountability and efficacy (9).

Notably, advanced information systems have demonstrated significant potential in improving humanitarian logistics outcomes. Tools such as GIS, cloud platforms, and mobile applications have facilitated better situational awareness, optimized routing, and real-time resource tracking. These innovations contribute to faster decision-making and more precise targeting of aid (10).

However, despite technological advancements and institutional reforms, gaps remain particularly in local-level capacity and data interoperability. Most literature and policies emphasize national and international coordination while overlooking the grassroots dimension of disaster logistics.

Community-based strategies and indigenous knowledge systems are critical yet under-researched components in building resilient logistics infrastructures (11,12).

Research Gap and Objectives: Despite global and national advances in disaster logistics, limited empirical research examines the interplay of systemic risk, adaptive responses, and governance in Indonesia's disaster-prone regions. This study addresses this gap by analyzing the 2018 Palu–Donggala case with three objectives: (1) to identify critical failure points in the logistics supply chain, (2) to evaluate the effectiveness of multi-actor coordination, and (3) to provide evidence-based recommendations for strengthening future humanitarian logistics.

METHOD

This study adopts a qualitative descriptive approach to explore risk management in humanitarian logistics operations following the 2018 Palu–Donggala earthquake and tsunami. This approach is suitable for capturing complex interactions among multiple actors in crisis contexts and allows the documentation of institutional dynamics and lived experiences.(13,14).

Fieldwork was conducted in Palu City and Donggala Regency, the two areas most affected by the disaster. Data collection took place between January and March 2019 with approval from local authorities and collaboration with humanitarian organizations. Participants were selected using purposive sampling based on three criteria: (1) direct involvement in logistics operations during the 2018 response, (2) affiliation with government agencies (BNPB, BPBD, PMI, TNI) or NGOs, and (3) willingness to provide detailed accounts. Ten key informants were ultimately interviewed. This number was deemed sufficient based on the principle of *data saturation*, as no new themes emerged after the 9th interview.

Data Collection Techniques

Three primary techniques were employed to gather data:

- In-depth Interviews: Semi-structured interviews were conducted with logistics personnel and field operators to capture experiential narratives and strategic reflections.
- Non-Participant Observation: Site visits were carried out at former distribution points and temporary logistics hubs to understand operational contexts and spatial logistics arrangements.
- Document Review: Official reports from BNPB, NGOs, and humanitarian logistics platforms such as Humanitarian Data Exchange (HDX), along with media documentation, were analyzed to triangulate interview and observation data.

Data Analysis

Thematic analysis was utilized to systematically identify and interpret recurring themes and patterns in the qualitative data, following the methodological framework proposed by Braun and

Clarke (2006). The process involved multiple stages: (1) transcription and initial familiarization with the data, (2) open coding to label salient concepts, (3) theme identification, (4) review and refinement of themes for internal consistency, and (5) synthesis into coherent thematic narratives.

This iterative and reflective process was supported by field memos and, where possible, assisted by qualitative analysis software such as NVivo. Thematic analysis proved effective in uncovering converging and diverging perspectives among various stakeholders and provided structured insight into operational bottlenecks and adaptive strategies (3,5).

Trustworthiness and Ethical Considerations

To ensure the trustworthiness of findings, the study employed the four criteria proposed by Lincoln and Guba (1985):

- Credibility was achieved through methodological triangulation using interviews, observation, and document analysis.
- Transferability was addressed by providing detailed contextual descriptions of the study settings.
- Dependability was maintained through systematic documentation of all research procedures (audit trail).
- Confirmability was strengthened by maintaining reflexivity and peer debriefing throughout the research process.

Ethical research standards were rigorously followed. Informed consent was obtained from all participants, with strict confidentiality protocols implemented to safeguard personal and institutional identities. Participation was entirely voluntary, and institutional research clearance was secured prior to fieldwork.

This comprehensive methodological design ensures the robustness of the study and supports the formulation of practical and contextually grounded recommendations for strengthening humanitarian logistics systems in Indonesia.

RESULT AND DISCUSSION

Thematic analysis produced four major themes: (1) infrastructure vulnerability, (2) data inconsistencies, (3) adaptive logistics strategies, and (4) coordination and system improvement. The relationships among these themes are summarized in Table 1.

Table 1. Key Findings of Post-Disaster Logistics in Palu and Donggala (2018)

Theme	Key Issues	Illustrative Quote	Implications
Infrastructure vulnerability	Collapse of Palu IV Bridge, blocked roads, airport shutdown	*"In the first days, logistics were completely stuck. Flights couldn't land directly; aid had to be rerouted through Makassar."* (BPBD informant)	Severe delays in mobilization; reliance on alternative routes
Data inconsistencies	Overlapping records of evacuees, uneven distribution	*"Some camps received excessive supplies, while others were neglected because the data was not updated."* (NGO informant)	Misallocation of aid; highlights need for real-time information systems
Adaptive strategies	Drone mapping, helicopter drops, logistics hubs, OpenStreetMap use	*"We used helicopters to deliver aid to Kulawi and Sigi when roads were inaccessible."* (TNI officer)	Innovation reduced isolation; technology enabled alternative delivery
Multi-actor coordination	Independent operations at first, later improved via Joint Command Post	*"So many agencies arrived, but at first there was no unified system. Everyone worked separately."* (PMI volunteer)	Initial inefficiency; improved once BNPB coordinated via national logistics platform
System improvement	Calls for village-level warehouses, community training	*"Logistics management should start from the village. Everything was centralized in Palu, which delayed responses in remote villages."* (Local NGO representative)	Need for decentralization and preparedness-based logistics

Identification of Post-Disaster Logistics Challenges

The initial response to the 2018 Palu and Donggala earthquake and tsunami was significantly hindered by severe infrastructural damage. According to multiple informants, the collapse of the main bridge in Palu, road blockages from landslides and liquefaction, and the operational shutdown of the airport for the first two days severely delayed logistics mobilization. One BPBD informant recalled: "In the first days, logistics were completely stuck. Flights couldn't land directly; aid had to be rerouted through Makassar and delayed further."

Such failures align with previous studies that emphasize the fragility of logistical systems in disaster-prone regions (15,16). Moreover, communication systems were impaired, which compounded delays in coordination and reporting.

Data inconsistencies regarding evacuees and their locations were another critical issue. Informants from NGOs described how overlapping or outdated records led to disproportionate aid allocation: some camps received excessive supplies while others were neglected. These issues underscore the need for robust and real-time data management systems (8,17).

Risk Mitigation Strategies in Humanitarian Logistics

Adaptive strategies were implemented by various actors to navigate logistical bottlenecks. Emergency logistic hubs were established at the Mutiara Sis Al-Jufri Airport, Pantoloan Port, and PMI Donggala office. These hubs functioned as transshipment points and temporary storage to circumvent blocked routes.

Innovative measures such as drone-assisted mapping and community radio coordination were adopted. A TNI officer reported, "We used helicopters to deliver aid to inaccessible areas like Kulawi and parts of Sigi," emphasizing the role of aerial support in reaching isolated communities. NGOs applied Open Street Map technology to identify alternative routes swiftly, particularly in rural areas lacking updated infrastructure data (18,19).

Multi-Actor Coordination in Logistics Operations

Coordination challenges were prominent in the early response phase. Disparate humanitarian actors operated independently, leading to duplicative efforts and wasted resources. A PMI volunteer noted: "So many agencies arrived, but there was no unified system initially. Everyone worked separately."

Improved coordination emerged in the second week post-disaster through the establishment of a Joint Command Post and a national logistics platform. The appointment of a logistics sector coordinator from BNPB facilitated better route planning and real-time need assessments. Literature supports the effectiveness of coordinated response structures in enhancing aid efficiency and transparency (20).

Evaluation and System Improvement Initiatives

Field evaluations highlighted the necessity of decentralizing logistical preparedness. Many informants emphasized community-level training and the pre-establishment of mini warehouses in high-risk zones. A local NGO representative stated, "Logistics management should start from the village. Everything was centralized in Palu, which delayed responses in remote villages."

Several actors also proposed integrating spatial risk mapping and regular simulation drills into regional contingency plans. The concept of prepositioning aid supplies and enhancing local governance capacities resonates with recent scholarship advocating for resilient, community-embedded logistics frameworks (21).

Overall, the empirical findings reveal both structural vulnerabilities and adaptive innovations in Palu and Donggala's disaster logistics system. These insights offer practical implications for enhancing future humanitarian logistics preparedness and response in Indonesia.

The 2018 earthquake and tsunami in Palu and Donggala, Indonesia, unveiled significant logistical challenges in humanitarian response operations. This discussion synthesizes field findings and theoretical perspectives to analyze five key dimensions: infrastructure vulnerability, systemic data weaknesses, strategic adaptability, coordination mechanisms, and supply chain resilience.

4.1 Infrastructure Vulnerability and Distribution Disruptions

The collapse of the Palu IV Bridge, blocked roads, and disrupted airport operations illustrated the fragility of Indonesia's logistics networks during major disasters. Similar vulnerabilities were observed in other earthquake cases, such as Erzincan (Yılmaz et al., 2019), confirming the global relevance of infrastructure redundancy in post-disaster settings. In the Indonesian context, Paton et al. (2021) highlight the importance of spatial planning and evacuation accessibility as central elements of resilient logistics infrastructure. This study reinforces those findings, demonstrating that archipelagic regions require decentralized hubs and multichannel distribution routes to mitigate bottlenecks (22, 23).

Systemic Risk: Data Inconsistencies and Information System Weaknesses

Aid distribution inefficiencies stemmed from mismatches between survivor data and actual logistical needs across shelters. These inconsistencies arose from poor interagency coordination, fragmented data systems, and a lack of real-time reporting platforms. Li et al. (2022) stress the role of accurate, transparent, and shared data in effective humanitarian logistics (24)2.

Delays in data collection, overlapping aid delivery, and unserved areas highlight a breakdown in information management. Strengthening logistics systems must go beyond physical assets to include adaptive information technologies. Integrating platforms like OCHA's Humanitarian Data Exchange and the Common Operating Picture (COP) into Indonesia's national system is imperative. GIS-based needs mapping and disaster dashboards also offer strategic tools to address these systemic risks.

Strategic Adaptability: Innovation and Flexibility in Logistics Response

Field responses in Palu and Donggala demonstrated the value of improvisation in logistics operations. Helicopter drops, alternative maritime routes, and community-based mapping apps exemplify adaptive strategies consistent with the "adaptive humanitarian logistics" framework (25).

However, these approaches remain ad hoc and outside institutional policy. Bridging this gap requires formal frameworks that embed innovation in disaster logistics. Governments must enable systemic deployment of drones, tracking systems, and AI-based risk mapping. Altay & Pal (2020) argue that modern humanitarian logistics must integrate emerging technologies to overcome structural limitations (21).

Multi-Actor Coordination and Governance Challenges

Initial response efforts lacked unified command, with multiple agencies acting independently. This exposed shortcomings in implementing the Incident Command System (ICS) in Indonesia. Wankmüller (2021) asserts that clear, transparent command structures are vital to avoid redundancy and role conflicts in humanitarian logistics (26).

BNPB's logistics cluster design, supported by WFP, faced execution barriers at local levels due to limited institutional capacity and technical training. Future logistics systems should empower local

institutions and communities for integrated yet autonomous distribution. Jahre et al. (2016) emphasize the critical role of local-national synergies in disaster logistics, particularly in archipelagic settings (27).

Supply Chain Resilience and Preparedness-Based Logistics Strategies

Findings revealed growing awareness of community-based preparedness. Proposals for pre-disaster logistics warehouses at the village level, volunteer training, and digital needs reporting reflect strategic thinking by field actors. These align with the supply chain resilience model that prioritizes recovery and adaptation post-disruption (28).

Prepositioning efforts by PMI and ACT improved response speed, validating the importance of localized contingency plans. National policy must incorporate such strategies into regional planning. Indonesia's Disaster Management Master Plan (RIPB) 2020–2044 already prioritizes logistics system strengthening. This study supports reformulating logistics policies based on risk, community empowerment, and information systems.

Study Limitations and Future Research

This study is limited by its small sample size (10 informants) and its localized scope (Palu and Donggala only). Therefore, findings may not fully represent diverse disaster contexts across Indonesia. Future research should involve comparative case studies in different provinces, larger informant pools, and the integration of mixed methods (e.g., survey-based quantitative data) to triangulate insights. Despite these limitations, the study contributes uniquely by grounding theoretical frameworks of risk and resilience in an empirical disaster setting, offering practical lessons for integrating adaptive and community-based strategies into Indonesia's humanitarian logistics system.

CONCLUSION

This study analyzed humanitarian logistics operations during the 2018 Palu–Donggala earthquake and tsunami, highlighting five critical dimensions: infrastructure vulnerability, systemic data weaknesses, adaptive responses, coordination challenges, and community-based preparedness. Findings show that damaged infrastructure and fragmented data systems severely hampered aid distribution, but field actors responded with innovative strategies such as drone mapping, helicopter drops, and the establishment of logistics hubs. Coordination improved in later stages through joint command posts and BNPB-led platforms, while stakeholders emphasized the importance of decentralization and local preparedness as foundations for resilient logistics systems. These insights contribute to the humanitarian logistics literature by grounding theoretical frameworks in empirical evidence from a complex disaster setting.

The study is limited by its small sample size and localized scope, focusing only on Palu and Donggala. Future research should expand to multiple disaster sites across Indonesia and apply mixed methods to strengthen generalizability. Despite these limitations, the unique contribution of this study lies in demonstrating how systemic risks and adaptive innovations interact in real disaster contexts, providing evidence-based recommendations for policy reform. It advocates for embedding community-based strategies, integrated information systems, and decentralized logistics models within Indonesia's disaster management framework to enhance agility, resilience, and institutional learning.

REFERENCE

Santos LBL, Soares GG, Garg T, Jorge AAS, Londe LR, Reani RT, et al. Vulnerability Analysis in Complex Networks Under a Flood Risk Reduction Point of View. Front Phys. 2023;11.

Bross L, Baumer JH, Voggenreiter I, Wienand I, Fekete A. Public Health Without Water? Emergency Water Supply and Minimum Supply Standards of Hospitals in High-Income Countries Using the Example of Germany and Austria. Water Policy. 2021;23(2):205–21.

Xu W, Li W, Proverbs D, CHEN W. An Evaluation of the Humanitarian Supply Chains in the Event of Flash Flooding. Water. 2023;15(18):3323.

Arowosegbe OB, Olutimehin DO, Odunaiya OG, Soyombo OT. Risk Management in Global Supply Chains: Addressing Vulnerabilities in Shipping and Logistics. Int J Manag Entrep Res. 2024;6(3):910–22.

Warnier M, Alkema V, Comes T, Walle BV d. Humanitarian Access, Interrupted: Dynamic Near Real-Time Network Analytics and Mapping for Reaching Communities in Disaster-Affected Countries. Spectr. 2020;42(3):815–34.

Zain RM, Zahari HM, Azhar NH, Uthrapathe PAA. Humanitarian Logistics in Disaster Preparedness: A Case Study of Monsoon Relief Distribution for Pulau Redang, Terengganu. J Def Manag Soc Sci Humanit. 2023;6(1).

Roy KC, Hasan S, Mozumder P. A Multilabel Classification Approach to Identify Hurricane-induced Infrastructure Disruptions Using Social Media Data. Comput-Aided Civ Infrastruct Eng. 2020;35(12):1387–402.

Aretoulaki E, Ponis ST, Plakas G. Complementarity, Interoperability, and Level of Integration of Humanitarian Drones With Emerging Digital Technologies: A State-of-the-Art Systematic Literature Review of Mathematical Models. Drones. 2023;7(5):301.

Cheng L, Hertelendy AJ, Hart A, Law LS, Hata R, Nouaime G, et al. Factors Associated With International Humanitarian Aid Appeal for Disasters From 1995 to 2015: A Retrospective Database Study. Plos One. 2023;18(6):e0286472.

Romero-Mancilla MS, Hernandez-Ruiz KE, Huerta-Muñoz DL. A Multiobjective Mathematical Model for a Humanitarian Logistics Multimodal Transportation Problem. J Humanit Logist Supply Chain Manag. 2023;14(3):247–61.

Oruc BE, Kara BY. Post-Disaster Assessment Routing Problem. Transp Res Part B Methodol. 2018;116:76–102.

Pamidimukkala A, Sharareh K, Sanjgna K. Impact of Natural Disasters on Construction Projects: Strategies to Prevent Cost and Schedule Overruns in Reconstruction Projects. 2020;49–57.

Toyasaki F, Arıkan E, Silbermayr L, Sigala IF. Disaster Relief Inventory Management: Horizontal Cooperation Between Humanitarian Organizations. Prod Oper Manag. 2017;26(6):1221–37.

Hakim RT, Kusumastuti RD. A Model to Determine Relief Warehouse Location in East Jakarta Using the Analytic Hierarchy Process. Int J Technol. 2018;9(7):1405.

Yılmaz Z, Aydemir-Karadag A, Erol S. Finding Optimal Depots and Routes in Sudden-Onset Disasters: An Earthquake Case for Erzincan. Transp J. 2019;58(3):168–96.

Salam MA, Khan SA. Lessons From the Humanitarian Disaster Logistics Management. Benchmarking Int J. 2020;27(4):1455–73.

Klokman VW, Barten DG, Peters NA, Versteegen MG, Wijnands JJ, Osch F v., et al. A Scoping Review of Internal Hospital Crises and Disasters in the Netherlands, 2000–2020. Plos One. 2021;16(4):e0250551.

Maharjan S, Dhakal L, George L, Shrestha B, Coombe H, Bhatta S, et al. Socio-Culturally Adapted Educational Videos Increase Maternal and Newborn Health Knowledge in Pregnant Women and Female Community Health Volunteers in Nepal's Khotang District. Women Health. 2022;18.

Shah B, Frederico GF, Kumar V, Garza-Reyes JA, Kumar A. Guest Editorial: The COVID-19 Impact on Humanitarian Operations: Lessons for Future Disrupting Events. J Humanit Logist Supply Chain Manag. 2022;12(4):473–81.

Zahari HM, Zain R, Ismail A, Zainol NAM, Yaacob S, Nik Ismail Rashed Che Ali. A Framework for Humanitarian Logistics Coordination in Disaster Relief. Iop Conf Ser Earth Environ Sci. 2025;1479(1):012061.

Altay N, Kovács G, Spens K. The Evolution of Humanitarian Logistics as a Discipline Through a Crystal Ball. J Humanit Logist Supply Chain Manag. 2021;11(4):577–84.

Yazdani M, Chatterjee P, Zavadskas EK, Zolfani SH. Integrated AHP–VIKOR for strategic logistics outsourcing decisions under a sustainability perspective. J Clean Prod. 2020;242:118384.

Paton D, Johnston D, Campbell E. Disaster resilience: Building capacity in the face of uncertainty. Int J Disaster Risk Reduct. 2021;57:102160.

Li Y, Yang Y, He W. An integrated information system for effective disaster relief logistics. Comput Ind Eng. 2022;169:108204.

Schiffling S, Hannibal C, Fan Y. A dynamic capabilities view of humanitarian supply chain resilience. Supply Chain Manag Int J. 2020;25(5):577–90.

Wankmüller C. Exploring coordination in humanitarian logistics: A social network perspective. J Humanit Logist Supply Chain Manag. 2021;11(1):79–105.

Jahre M, Kembro J, Adjahossou A, Altay N. Approaches to the management of humanitarian logistics. J Humanit Logist Supply Chain Manag. 2016;6(3):324–48.

Ivanov D, Dolgui A. Low-certainty-need (LCN) supply chains: A new perspective in managing disruption risks and resilience. Int J Prod Res. 2019;57(15–16):5119–36.

Qin, D. (2024). Factor Study: Factors Influencing GRP in Various Provinces of China. *Highlights in Business Economics and Management*, *24*, 692–697. https://doi.org/10.54097/fsqv9p41

Russo, F., & Comi, A. (2016). Urban Freight Transport Planning towards Green Goals: Synthetic Environmental Evidence from Tested Scenarios. *Sustainability*, *8*(4), 381. https://doi.org/10.3390/su8040381

Russo, S., Ronchetti, M., Tecco, C. D., Valenti, A., Jain, A., Mennini, F. S., Leka, S., & Iavicoli, S. (2021). Developing a Cost-Estimation Model for Work–related Stress: An Absence-Based Estimation Using Data From Two Italian Case Studies. *Scandinavian Journal of Work Environment & Health*, *47*(4), 318–327. https://doi.org/10.5271/sjweh.3948

Sahu, P. K., Pani, A., & Santos, G. (2022). Freight Traffic Impacts and Logistics Inefficiencies in India: Policy Interventions and Solution Concepts for Sustainable City Logistics. *Transportation in Developing Economies*, *8*(2). https://doi.org/10.1007/s40890-022-00161-8

Taniguchi, E., Thompson, R. G., & Yamada, T. (2020). New Opportunities in Urban Freight Transport Research: Lessons from Recent Advances. *Transport Reviews*, *40*(5), 620–638. https://doi.org/10.1080/01441647.2020.1738580

Yakeen, F. (2024). Acceptability of Sustainable Logistics Measures for Fuel Distribution by Tanker Trucks in Nigeria. *Ijir*, *2*(5), 379–388. https://doi.org/10.59890/ijir.v2i5.1567

Zhang, D. (2021). Fiscal Policy Benefits and Green Recovery of Firms: An Experimental Exploration of Chinese Listed Firms in Post-Covid-19. *Economic Change and Restructuring*, *56*(5), 2921–2942. https://doi.org/10.1007/s10644-021-09344-6