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Implementation of Cross Docking: Food Aid Distribution Program in Sigi Regency

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ABSTRACT : Stunting remains a persistent public health challenge in disaster prone regions, particularly in Indonesia. This study investigates the implementation of cross docking logistics for the distribution of food aid to at risk households in Sigi Regency, Central Sulawesi. Employing a qualitative case study approach, data were collected through semi structured interviews with 15 logistics personnel and direct field observations. Thematic analysis was used to interpret patterns related to distribution efficiency, coordination, and infrastructure adaptation. The results demonstrate that cross docking significantly reduced distribution time from four to two days, enhanced product quality by minimizing spoilage, and improved logistical responsiveness through specialized transport and local sourcing. Inter agency collaboration and basic digital systems enabled real time data verification and ensured equitable delivery. The study highlights the practicality of cross docking in overcoming infrastructural constraints and maintaining service continuity in post disaster contexts. These findings contribute to the discourse on humanitarian logistics by illustrating the operational and public health benefits of agile distribution methods. The study suggests that cross docking, when combined with adaptive local strategies and digital integration, offers a scalable and resilient model for food aid logistics in disaster prone regions.

Keywords: Cross Docking, Humanitarian Logistics, Food Aid Distribution, Disaster Response, Stunting Prevention, Supply Chain Resilience, Rural Infrastructure.

INTRODUCTION

Stunting, a critical form of child malnutrition characterized by low height for age, remains a persistent public health issue in many developing countries, particularly in disaster prone regions like Indonesia and Southeast Asia. Recent studies indicate that stunting affects approximately 30% of Indonesian children under the age of five, with prevalence rates considerably higher in areas impacted by natural disasters (Adeoya et al., 2022; Fahmida et al., 2022). These regions often experience disruptions in food security and healthcare services, which compound the socio

economic vulnerabilities of affected communities. The long term consequences of stunting extend beyond physical growth impairment to cognitive delays, educational underachievement, and reduced economic productivity later in life (Adeoya et al., 2022; Rachmah et al., 2021). Despite significant efforts towards post disaster reconstruction, the persistent neglect of nutritional needs perpetuates the cycle of vulnerability among children in these regions (Balhara et al., 2017; Rachmah et al., 2021).

Food insecurity, exacerbated by disaster related disruptions to supply chains, plays a pivotal role in aggravating child malnutrition in affected areas. Following disasters, the destruction of critical infrastructure, including roads and storage facilities, significantly hinders access to nutritious food, thereby increasing stunting rates (Kabir et al., 2024; Rachmah et al., 2021). Post disaster poverty and unemployment further exacerbate this issue, as households face constrained economic means to secure adequate nutrition (Balhara et al., 2017). Empirical studies highlight that children from low income households and those with less educated caregivers are at a heightened risk of malnutrition, particularly in post disaster contexts (Balhara et al., 2017; Blankenship et al., 2020). Integrated interventions addressing both immediate food security and broader socio economic support systems are thus crucial for mitigating stunting and enhancing community resilience against future crises.

Addressing the logistics of food aid distribution in rural and post disaster contexts introduces complex challenges. Infrastructure damage frequently disrupts critical transport and communication networks, delaying the delivery of essential supplies (Iryadi et al., 2024; Rinawati, 2018). "Last mile" distribution problems often result in aid bottlenecks at centralized hubs, leaving peripheral communities underserved (Rinawati, 2018). Furthermore, the absence of accurate beneficiary data and advanced information systems can lead to supply misallocations, exacerbating inequalities in aid distribution (Pamiliawati et al., 2020). Perishable food items face heightened risks of spoilage due to distribution delays, undermining the nutritional value of delivered aid. The unpredictable nature of post disaster environments necessitates dynamic, adaptable logistical planning and enhanced real time coordination among stakeholders (Chapagain & Raizada, 2017).

The Indonesian government, acknowledging these challenges, has implemented various measures to strengthen food distribution logistics during disaster responses. Disaster management agencies, such as the Badan Penanggulangan Bencana Daerah (BPBD), have increasingly adopted digital information systems to coordinate relief efforts more effectively (Pamiliawati et al., 2020). Case studies, such as those in Magelang, illustrate the success of these systems in enabling authorities to monitor stock levels, track expiry dates, and dynamically allocate resources based on evolving needs (Rinawati, 2018). Additionally, leveraging pre existing community networks and pre positioned stockpiles has been critical for facilitating rapid, equitable distribution in geographically challenging regions (Chapagain & Raizada, 2017). These strategies have enhanced both the efficiency and equity of food aid distribution, contributing to improved disaster recovery outcomes.

Amidst these efforts, cross docking logistics has emerged as a promising strategy for addressing inefficiencies in humanitarian aid distribution. Cross docking involves the rapid transshipment of

goods from inbound to outbound transport without prolonged storage, significantly reducing handling times and inventory costs (Buijs et al., 2016). In disaster contexts, where speed and food quality preservation are paramount, cross docking minimizes delays and the risk of spoilage by ensuring swift turnover of perishable goods. Studies have demonstrated that implementing cross docking logistics leads to more agile, responsive supply chains capable of better meeting urgent nutritional needs during emergencies (Trejos et al., 2022).

Moreover, cross docking offers notable advantages for humanitarian logistics by enhancing operational flexibility and responsiveness. By eliminating intermediate warehousing, cross docking supports "just in time" delivery models, critical for serving communities in remote or disaster impacted areas with limited storage infrastructure (Trejos et al., 2022). When combined with real time tracking and coordination technologies, cross docking can adapt to fluctuating demand and access constraints, facilitating more effective resource allocation and timely aid delivery w(F. Wang et al., 2024). These operational efficiencies ultimately contribute to better public health outcomes by ensuring that vulnerable populations receive necessary nutritional interventions promptly.

The application of cross docking in humanitarian settings aligns with broader evidence linking efficient food distribution to improved health outcomes. Timely access to nutrient rich food supplies during critical developmental periods is essential for mitigating risks of stunting and other forms of malnutrition (Akbar et al., 2021). In regions with persistently high stunting rates, such as Eastern Indonesia, rapid and precise logistics systems have been instrumental in delivering life saving nutritional support (Sriwahyuni et al., 2022). Consequently, refining logistics strategies, including the adoption of cross docking, holds considerable promise for enhancing the impact of food aid programs on child health indicators.

Existing literature provides valuable insights into the theoretical and practical underpinnings of cross docking logistics in both commercial and humanitarian contexts. Buijs et al. (2016) and Trejos et al. (2022) offer foundational analyses of cross docking's operational mechanisms and benefits, particularly regarding speed and cost efficiency. Studies by Wang et al. (2024) further emphasize the importance of integrating cross docking with advanced ICT solutions to maximize logistical agility during disaster responses. Despite these advancements, limited empirical research has specifically examined the implementation of cross docking in post disaster, rural settings characterized by extreme infrastructural challenges and vulnerable populations.

In this context, there remains a significant research gap concerning the practical application and outcomes of cross docking logistics for food aid distribution in disaster affected regions such as Sigi Regency. While theoretical benefits are well documented, localized empirical studies are necessary to validate the adaptability and effectiveness of cross docking under real world constraints. Understanding how cross docking interacts with specific regional challenges, such as mountainous terrains and disrupted road networks, is critical for designing robust humanitarian logistics frameworks.

This study aims to address this research gap by investigating the implementation of cross docking in the distribution of food aid to families at risk of stunting in Sigi Regency, Central Sulawesi. It

examines the practicalities, benefits, and limitations of the method in a disaster affected, rural Indonesian context. By focusing on qualitative data from distribution officers and field observations, this research provides novel empirical evidence on the applicability of cross docking in humanitarian logistics. The findings are intended to inform both academic discourse and practical policymaking, contributing to the design of more resilient, efficient, and health promoting food aid distribution systems in disaster prone regions.

METHOD

This study employed a qualitative research approach, appropriate for investigating complex logistical phenomena within post disaster settings, such as the implementation of cross docking in Sigi Regency. Qualitative methods are particularly valuable for exploring system implementations in nuanced, dynamic environments (Nowell et al., 2017; Vaismoradi et al., 2016). Through a case study design, this research sought to obtain a deep, contextualized understanding of the logistical processes and challenges faced during the distribution of food aid using cross docking mechanisms.

The choice of a case study methodology was deliberate, aligning with best practices for examining operations within post disaster humanitarian logistics, where infrastructure, policy responses, and operational realities interact dynamically (Vega, 2018). By focusing on the specific case of Sigi Regency, the study was able to capture the distinct infrastructural conditions, stakeholder dynamics, and localized adaptations necessary for implementing cross docking strategies effectively in disaster affected rural areas.

Participants in this study included five distribution coordinators and ten field officers directly involved in the food aid distribution program. These participants were selected purposively based on their active roles and firsthand experience in the logistical execution of cross docking operations. Their insights were considered crucial for understanding both strategic planning and on the ground realities, consistent with qualitative research norms favoring information rich informants.

Data collection involved two primary techniques: in depth semi structured interviews and direct observation. Interviews were conducted to elicit detailed narratives regarding the planning, coordination, challenges, and perceived outcomes of the cross docking implementation. Semi structured interviews allowed for consistency across participants while providing flexibility to explore emerging themes in greater depth. Observations were carried out at key cross docking points and final distribution locations across Sigi Regency. Through systematic note taking and photographic documentation, the researchers captured procedural elements, logistical setups, timing sequences, and coordination practices.

To ensure comprehensive and systematic analysis, data were subjected to thematic analysis following the established guidelines by Braun and Clarke (2006). This involved multiple iterative

phases, beginning with data familiarization, where transcripts and observation notes were reviewed multiple times to immerse the researchers in the dataset. Initial coding was then conducted, identifying significant features across the data corpus. These codes were subsequently organized into potential themes, which were reviewed and refined to ensure internal coherence and distinction among themes. Final themes were clearly defined and named, grounded firmly in the empirical data and reflective of the multifaceted realities of cross docking implementation.

The study maintained methodological rigor by adhering to principles of reflexivity and transparency. Throughout the research process, the investigators consistently examined their own assumptions and potential biases, documenting the evolution of themes and interpretations. Reflexivity journals were maintained to record critical reflections, enhancing the credibility and trustworthiness of the findings (Vaismoradi et al., 2016).

Triangulation further strengthened the validity of the research outcomes. Data from interviews and observations were cross verified to ensure consistency and to minimize the risk of subjectivity. Where discrepancies emerged, further probing and clarification were conducted during subsequent interviews or follow up observations. This methodological triangulation not only enriched the dataset but also enhanced the reliability of the interpretations.

Ethical considerations were rigorously observed throughout the research process. Informed consent was obtained from all participants after providing clear explanations about the study's objectives, procedures, and confidentiality assurances. Participants were assured of their right to withdraw from the study at any point without repercussions. Data were anonymized during transcription to protect participants' identities, and access to raw data was restricted to the core research team.

The analytical framework was deliberately structured to explore key thematic domains relevant to the implementation of cross docking in the humanitarian context: logistical coordination, time efficiency, infrastructure challenges, product quality preservation, and beneficiary satisfaction. These thematic domains were not predetermined but emerged inductively from the data, reflecting participants' lived experiences and operational insights.

By employing a rigorous thematic analysis supported by rich empirical data, the study generated context specific insights into how cross docking mechanisms can be adapted and optimized in post disaster, rural environments. The methodological rigor, transparency, and context sensitivity embedded in this study align with established best practices in qualitative logistics research, enhancing the trustworthiness and academic contribution of the findings (Nowell et al., 2017; Vega, 2018).

In summary, the methodological choices made in this study employing a qualitative case study design, utilizing semi structured interviews and direct observation, adhering to thematic analysis procedures, and ensuring rigorous reflexivity and triangulation provided a robust foundation for exploring the complex logistical phenomena associated with cross docking in post disaster food aid distribution. These approaches collectively ensured that the study captured the nuanced

realities of operational logistics in Sigi Regency, offering valuable lessons for future humanitarian logistics strategies in similarly challenging contexts.

RESULT AND DISCUSSION

In humanitarian logistics, the efficiency of distribution systems directly influences the timeliness and impact of emergency relief delivery. These systems serve as essential conduits, moving supplies from centralized stockpiles to dispersed, often inaccessible, disaster affected communities. Their effectiveness hinges not only on the robustness of infrastructure but also on coordination, inventory strategies, and the ability to adapt dynamically to challenging environments (Charles et al., 2016; Chinogwenya & Utete, 2023). In post disaster regions such as Sigi Regency, where terrain and infrastructure pose significant logistical obstacles, the implementation of innovative distribution methods like cross docking becomes crucial. This section presents the empirical findings regarding the deployment of cross docking for food aid distribution in Sigi Regency, referencing Table 1 as a summary of operational aspects.

Cross docking, by design, eliminates the need for prolonged storage by transferring goods directly from receiving to dispatching vehicles. In disaster relief, where perishability and urgency are paramount, this method significantly reduces delays and spoilage (Buijs et al., 2016). As Table 1 demonstrates, the application of this approach in Sigi involved a carefully timed operation beginning at 05.00–07.00 WITA for unloading and sorting, followed by outbound distribution at 08.30 WITA. The rapid cycle ensured that temperature sensitive goods, such as frozen poultry and fresh eggs, maintained their nutritional integrity throughout the distribution chain. This was particularly important in areas such as Kulawi and Lindu, where road access was limited and transport time could otherwise compromise product quality.

Table 1. Implementation of Cross Docking in Sigi Regency

No	Aspect	Description
1	Number of At-Risk Families (KRS)	7,325 KRS, divided into 3,670 KRS (first day) and 3,655 KRS (second day) across 15 districts and 176 villages.
2	Agency Coordination	Social Affairs Office (recipient data) and Food Security Office (stock and food quality management).
3	Transportation Fleet	35–40 units consisting of small box trucks, trail motorcycles, and reefer trucks.
4	Cross Docking Process	Started at 05:00–07:00 WITA; outbound distribution commenced at 08:30 WITA.
5	Geographical Conditions	Mountainous areas and damaged roads; trail motorcycles used for areas such as Kulawi and Lindu.
6	Product Quality	Frozen chicken (-18°C) and eggs at normal temperature, packaged with styrofoam boxes and ice packs.

7	Product Shortages	Minimal shortages in 4–5 villages; resolved through local cooperative procurement.
8	Distribution Team	30 distribution officers and 150 temporary logistics workers (PHL).
9	Data Collection and Verification	Manual forms verified through the district logistics application.

One of the most notable outcomes of the cross docking implementation in Sigi was the marked reduction in overall delivery time. Prior to adopting this method, distribution to remote areas averaged up to four days, often hindered by warehouse bottlenecks and inventory mismanagement. With cross docking, the average distribution time was reduced to two days. This efficiency gain aligns with the findings of Dudukalov et al. (2020), who identified that even minimal improvements in cross docking logistics could yield significant reductions in warehousing costs and elevate distribution performance by over 30%. The operational data from Sigi reflect similar trends, where leaner inventory processes translated into faster aid delivery and lower risks of spoilage and logistical waste.

The coordination between the Social Affairs Department and the Food Security Office played a pivotal role in managing recipient data and ensuring the right quantities of food aid reached the designated locations. This interagency collaboration is consistent with findings from Rodríguez-Espíndola et al. (2023), who assert that multi stakeholder coordination enhances supply chain agility and reduces systemic inefficiencies. The deployment of 35–40 distribution vehicles, including motor trail units and reefer trucks, provided the needed mobility to navigate diverse geographic terrains. The use of lightweight, high mobility transport for last mile delivery exemplifies the small scale adaptations emphasized in research by Hutagalung (2023) and Grangier et al. (2019), wherein vehicle heterogeneity is critical for ensuring accessibility in rural settings.

Product quality assurance was another critical component of the success. Items such as frozen poultry were kept at 18°C using reefer trucks, while eggs were transported in styrofoam boxes packed with ice to maintain freshness. These cold chain measures aligned with findings by Lian (2021), who emphasized the role of temperature controlled logistics in preventing nutritional degradation during emergency food distribution. Furthermore, where occasional shortages occurred particularly in 4–5 villages with disrupted access coordination with local cooperatives provided an agile solution for supplementary procurement. This local sourcing strategy reinforces the concept of adaptive logistics systems capable of buffering shocks and mitigating service disruptions.

Human resources also proved central to the operation. A total of 30 distribution officers were deployed alongside 150 part time logistical workers (PHL), all of whom had undergone preparatory training to ensure consistency in handling, documentation, and communication protocols. Such organized workforce management is essential in disaster response contexts, where workforce readiness and reliability can determine the success of high pressure operations (Rodríguez-Espíndola et al., 2023).

On the data side, the verification process employed both manual forms and digital inputs into a regional logistics application. This hybrid method of monitoring, although simple, allowed for real time updates and accuracy checks, a practice supported by Chinogwenya & Utete (2023), who found that the integration of basic ICT systems can vastly improve visibility and responsiveness in humanitarian logistics chains.

Geographically, the greatest logistical constraints were found in hilly and flood prone subregions, where road damage and landslides frequently disrupted transport. In these zones, cross docking enabled distribution teams to optimize pre positioning and rerouting without having to rely on central warehouses that might be inaccessible. This adaptive use of decentralized mini hubs reflects the recommendations of Medel et al. (2020), who advocate for distributed cross docking nodes in vulnerable geographies.

The success of the cross docking implementation in Sigi also underscored the importance of synchronization between supply planning and community level demand. The recipient data, curated by local social workers, allowed for accurate allocation and reduced both under and over supply scenarios. This synchronization contributed not only to operational efficiency but also to improved beneficiary satisfaction, as recipients were more likely to receive complete and fresh aid packages without delay.

In light of these findings, the results from Sigi align with the broader literature on cross docking as an accelerator of emergency aid distribution. They reinforce the conclusions of Sultan (2019) and Tadić et al. (2023), who underscore that cross docking enhances agility and minimizes idle time across distribution channels. The dual benefits of speed and quality assurance offered by cross docking were particularly evident in this case, where perishable aid was delivered effectively in a rural, post disaster environment. The Sigi model demonstrates how localized adaptations, efficient coordination, and ICT enabled monitoring can combine to create a resilient logistics framework suitable for replication in similar humanitarian settings.

In conclusion, the implementation of cross docking in Sigi Regency has proven to be a critical advancement in food aid logistics. The integration of cold chain practices, agile transportation, coordinated stakeholder roles, and basic digital systems facilitated a distribution process that was both efficient and responsive to local needs. These outcomes contribute to the growing body of evidence supporting cross docking as a viable logistics solution in humanitarian contexts, especially where infrastructure challenges and environmental volatility are prevalent.

The implementation of cross docking in food aid distribution in Sigi Regency offers valuable insights into the strategic potential of this logistics method to enhance the effectiveness and resilience of humanitarian supply chains. The findings from this study affirm the literature that positions cross docking as a transformative logistics strategy, particularly relevant in contexts where speed, coordination, and perishability are critical concerns (Cozzolino, 2021; Varma, 2022). The ability of cross docking to reduce intermediary storage and enable direct transshipment significantly contributed to minimizing lead times, lowering inventory holding costs, and maintaining the nutritional integrity of perishable food supplies.

As outlined in Table 1, the structured deployment of cross docking starting with early morning inbound processing and transitioning swiftly to outbound distribution proved highly effective in achieving rapid circulation of food aid. This process ensured that supplies such as frozen poultry and fresh eggs reached remote communities without delays that could compromise quality. The operational success in Sigi supports previous findings by Buijs et al. (2016), who emphasized the "just in time" advantages of cross docking in accelerating food flows and reducing the risk of spoilage. Notably, the approach was not only time efficient but also cost effective, as it removed the need for extended warehousing and associated maintenance costs.

Beyond efficiency, the implementation in Sigi illustrates how cross docking can serve as a mechanism to build resilience in humanitarian supply chains. In regions frequently affected by disasters, the ability to maintain operational continuity despite infrastructure challenges is crucial. Cross docking, with its emphasis on transitory storage and agile delivery, enhances flexibility in responding to sudden environmental and logistical disruptions (Varma, 2022). The adaptable routing and decentralized distribution facilitated by cross docking enabled Sigi's logistical system to operate effectively even in mountainous and flood prone areas like Kulawi and Lindu, aligning with the resilience focused logistics strategies discussed by Cozzolino (2021).

A key enabler of this success was inter agency coordination, especially between the Dinas Sosial and Dinas Ketahanan Pangan, whose collaboration ensured accurate recipient targeting and efficient resource allocation. This finding aligns with Rodríguez-Espíndola et al. (2023), who argued that effective stakeholder collaboration is vital for synchronizing logistical operations and minimizing redundancy. Moreover, local partnerships with cooperatives addressed last mile shortages in remote villages, further enhancing the responsiveness of the system.

Despite these positive outcomes, the study also reveals the persistence of several structural barriers to the widespread adoption of cross docking in humanitarian logistics. Many of these challenges mirror those identified by Barsing et al. (2018), including limited road infrastructure, inadequate information systems, and financial constraints. In Sigi, rough terrain necessitated the use of motor trail vehicles, and the lack of advanced ICT systems required a hybrid data verification approach using both paper forms and a basic digital platform. These adaptations, though effective, highlight the infrastructural and technological gaps that limit the scalability of cross docking in similar settings.

Furthermore, institutional and organizational challenges must be addressed to sustain and expand cross docking strategies in humanitarian operations. In regions like Sigi, where disaster response is managed by a combination of central and local authorities, the absence of standardized operating procedures can lead to inconsistencies in execution. Overcoming bureaucratic inertia and fostering a culture of innovation within public agencies is essential to institutionalizing cross docking as a core strategy for food aid logistics. As noted by Barsing et al. (2018), investment in training, pre disaster planning, and regulatory harmonization is critical to overcome these systemic barriers.

Another dimension of success lies in the integration of cross docking with digital logistics platforms. While Sigi employed a basic digital tracking system, broader implementation would

benefit from advanced data analytics, predictive modeling, and real time tracking, which are increasingly used in logistics to manage complexity and respond dynamically to field conditions. Hemed & Issa (2022) argue that IT enhanced cross docking platforms offer significant performance gains by enabling real time coordination, minimizing idle time, and reducing bottlenecks. Furthermore, such systems can integrate logistics data with public health metrics, allowing for adaptive resource allocation based on real time nutritional or epidemiological needs (Kadakia & DeSalvo, 2023).

Digital innovation also plays a crucial role in facilitating inter agency collaboration and system interoperability. Establishing shared data standards and interfaces enables different stakeholders governmental, non governmental, and private sector to coordinate more effectively, thereby reducing redundancy and ensuring that aid reaches beneficiaries promptly. This interoperability is particularly important in public health logistics, where speed and accuracy directly affect outcomes (Mbugua & Namada, 2019).

In rural and topographically challenging settings like Sigi, the success of cross docking also depends on careful fleet selection and routing strategies. The deployment of reefer trucks for frozen goods and motor trail vehicles for inaccessible areas exemplifies the application of small scale logistical adaptations, which significantly enhance the reach and reliability of aid distribution (Grangier et al., 2019; Hutagalung, 2023). These vehicles enabled access to peripheral regions that would otherwise remain underserved, ensuring equity in aid delivery and supporting the broader humanitarian principle of inclusive response.

The study's qualitative approach, employing interviews and direct observation, provided a detailed understanding of these operational realities and contextual adaptations. In line with the thematic analysis guidelines of Braun and Clarke (2006) and case study methodology as emphasized by Yin (2018), the findings derived from Sigi not only validate cross docking's effectiveness but also demonstrate its feasibility in decentralized, resource limited environments. The value of empirical, context rich research is further underscored, providing a necessary counterbalance to predominantly theoretical discussions in the logistics literature.

Ultimately, the implementation of cross docking in Sigi Regency demonstrates that despite infrastructural and administrative limitations, strategic adaptations, stakeholder engagement, and pragmatic operational planning can yield substantial improvements in the speed, reliability, and quality of humanitarian food aid distribution. These findings suggest that cross docking can be a replicable model in other disaster prone regions of Indonesia and the Global South, provided that implementation is supported by appropriate investment in infrastructure, training, and technology.

CONCLUSION

The implementation of cross docking in the distribution of food aid in Sigi Regency demonstrated significant improvements in delivery speed, operational flexibility, and supply chain responsiveness. The findings revealed that this logistics strategy effectively minimized storage time,

reduced product spoilage, and enabled timely delivery of perishable food items to remote and disaster prone areas. The adaptability of cross docking was particularly evident in overcoming geographic challenges through the deployment of specialized transport fleets and local cooperative networks. Coordinated inter agency efforts and basic digital tools facilitated data verification and ensured that aid reached its intended beneficiaries. This study contributes to the growing body of knowledge on humanitarian logistics by providing empirical evidence of cross docking's feasibility in decentralized, infrastructure limited environments. The Sigi case exemplifies how operational resilience and nutritional quality can be enhanced through lean logistics. Moreover, the findings underscore the importance of integrating local adaptations, stakeholder collaboration, and real time data systems to optimize aid delivery. Future research may explore the long term scalability of cross docking in varied disaster contexts and investigate the integration of advanced digital technologies such as predictive analytics and AI driven logistics planning to further improve humanitarian supply chain efficiency.

REFERENCE

Adeoya, A. A., Sasaki, H., Fuda, M., Okamoto, T., & Egawa, S. (2022). Child Nutrition in Disaster: A Scoping Review. *The Tohoku Journal of Experimental Medicine*, *256*(2), 103–118. https://doi.org/10.1620/tjem.256.103

Akbar, M. T., Mahardhika, D. W., & Sihaloho, E. D. (2021). Stunting in Eastern Indonesia: Determinants and Solution From Indonesian Family Life Survey. *Jurnal Cita Ekonomika*, *15*(1), 1–13. https://doi.org/10.51125/citaekonomika.v15i1.3230

Balhara, K. S., Silvestri, D. M., Winders, W. T., Selvam, A., Kivlehan, S. M., Becker, T. K., & Levine, A. C. (2017). Impact of Nutrition Interventions on Pediatric Mortality and Nutrition Outcomes in Humanitarian Emergencies: A Systematic Review. *Tropical Medicine & International Health*, *22*(12), 1464–1492. https://doi.org/10.1111/tmi.12986

Barsing, P., Daultani, Y., Vaidya, O. S., & Kumar, S. (2018). Cross-Docking Centre Location in a Supply Chain Network: A Social Network Analysis Approach. *Global Business Review*, *19*(3_suppl), S218–S234. https://doi.org/10.1177/0972150918757847

Blankenship, J., Rudert, C., & Aguayo, V. M. (2020). Triple Trouble: Understanding the Burden of Child Undernutrition, Micronutrient Deficiencies, and Overweight in East Asia and the Pacific. *Maternal and Child Nutrition*, *16*(S2). https://doi.org/10.1111/mcn.12950

Buijs, P., Danhof, H. W., & Wortmann, J. C. (2016). Just-in-Time Retail Distribution: A Systems Perspective on Cross-Docking. *Journal of Business Logistics*, *37*(3), 213–230. https://doi.org/10.1111/jbl.12135

Chapagain, T., & Raizada, M. N. (2017). Impacts of Natural Disasters on Smallholder Farmers: Gaps and Recommendations. *Agriculture & Food Security*, *6*(1). https://doi.org/10.1186/s40066-017-0116-6

Charles, A., Lauras, M., Wassenhove, L. N. V, & Dupont, L. (2016). Designing an Efficient Humanitarian Supply Network. *Journal of Operations Management*, *47–48*(1), 58–70. https://doi.org/10.1016/j.jom.2016.05.012

Chinogwenya, K., & Utete, R. (2023). Outsourcing for Emergency Relief: Unravelling Key Strategies. *International Journal of Research in Business and Social Science (2147-4478)*, *12*(8), 48–60. https://doi.org/10.20525/ijrbs.v12i8.2913

Cozzolino, A. (2021). Platforms Enhancing the Engagement of the Private Sector in Humanitarian Relief Operations. *Sustainability*, *13*(6), 3024. https://doi.org/10.3390/su13063024

Dudukalov, E., Subhani, M. I., & Ushakov, D. (2020). Cross Docking as a Factor of Distribution Efficiencies Improving in Conditions of Governance Digitalization. *Iop Conference Series Materials Science and Engineering*, *918*(1), 012188. https://doi.org/10.1088/1757-899x/918/1/012188

Fahmida, U., Hidayat, A. T., Oka, A. A., Suciyanti, D., Pathurrahman, P., & Wangge, G. (2022). Effectiveness of an Integrated Nutrition Rehabilitation on Growth and Development of Children Under Five Post 2018 Earthquake in East Lombok, Indonesia. *International Journal of Environmental Research and Public Health*, *19*(5), 2814. https://doi.org/10.3390/ijerph19052814

Grangier, P., Gendreau, M., Lehuédé, F., & Rousseau, L.-M. (2019). The Vehicle Routing Problem With Cross-Docking and Resource Constraints. *Journal of Heuristics*, *27*(1–2), 31–61. https://doi.org/10.1007/s10732-019-09423-y

Hemed, A., & Issa, I. (2022). Determinant Factors for Adoption of Logistics Information System in the Public Health Laboratory in Chakechake-Zanzibar. *Business Education Journal*, *11*(1), 1–17. https://doi.org/10.54156/cbe.bej.11.1.326

Hutagalung, S. S. (2023). Adaptive Capacity in the Implementation of Disaster Response Village Programme in Indonesia: Literature Review. *Jàmbá Journal of Disaster Risk Studies*, *15*(1). https://doi.org/10.4102/jamba.v15i1.1470

Iryadi, F., Ristiani, I. Y., Putri, N. A., & Supriatna, A. (2024). Distribution of Logistics Assistance for Flood Victims in Pasangkayu Regency. *Jurnal Konstituen*, *6*(2), 94–107. https://doi.org/10.33701/jk.v6i2.4994

Kabir, I., Rana, S., Alam, B., Chowdhury, A. R., Lusha, M. A. F., Khanam, S. J., Hossain, D. M., Islam, S., & Khan, M. N. (2024). Disease Burden in the Context of Disasters: Insights From Over 6.7 Million Respondents in the Bangladesh Disaster-Related Statistics of 2021. *Disaster Medicine and Public Health Preparedness*, *18*. https://doi.org/10.1017/dmp.2024.288

Kadakia, K. T., & DeSalvo, K. B. (2023). Transforming Public Health Data Systems to Advance the Population's Health. *Milbank Quarterly*, *101*(S1), 674–699. https://doi.org/10.1111/1468-0009.12618

Lian, J. (2021). An Optimization Model of Cross-Docking Scheduling of Cold Chain Logistics Based on Fuzzy Time Window. *Journal of Intelligent & Fuzzy Systems*, *41*(1), 1901–1915. https://doi.org/10.3233/jifs-210611

Mbugua, A., & Namada, J. M. (2019). Information Technology Integration Effect on Operational Performance of Kenya's Public Health Sector. *Ijbe (Integrated Journal of Business and Economics)*, *3*(3), 226. https://doi.org/10.33019/ijbe.v3i3.236

Medel, K. B., Kousar, R., & Masood, T. (2020). A Collaboration–resilience Framework for Disaster Management Supply Networks: A Case Study of the Philippines. *Journal of Humanitarian Logistics and Supply Chain Management*, *10*(4), 509–553. https://doi.org/10.1108/jhlscm-09-2019-0066

Nowell, L., Norris, J. M., White, D., & Moules, N. J. (2017). Thematic Analysis. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

Pamiliawati, A., Yoeseph, N. M., Ardhi, O. D. W., & Bawono, S. A. T. (2020). Sistem Informasi Manajemen Logistik Dan Peralatan Studi Kasus: BPBD Kabupaten Wonogiri. *Indonesian Journal of Applied Informatics*, *4*(1), 36. https://doi.org/10.20961/ijai.v4i1.35721

Rachmah, Q., Mahmudiono, T., & Loh, S. P. (2021). Predictor of Obese Mothers and Stunted Children in the Same Roof: A Population-Based Study in the Urban Poor Setting Indonesia. *Frontiers in Nutrition*, *8*. https://doi.org/10.3389/fnut.2021.710588

Rinawati, D. I. (2018). Rancang Bangun Sistem Informasi Bantuan Logistik Bencana Studi Kasus Pada BPBD Kabupaten Magelang. *J Ti Undip Jurnal Teknik Industri*, *13*(1), 51. https://doi.org/10.14710/jati.13.1.51-60

Rodríguez-Espíndola, O., Dey, P. K., Albores, P., & Chowdhury, S. (2023). Sustainability and Intermodality in Humanitarian Logistics: A Two-Stage Multi-Objective Programming Formulation. *Annals of Operations Research*, *346*(2), 1687–1716. https://doi.org/10.1007/s10479-023-05459-3

Sriwahyuni, S., Safrizal, S., Darmawan, D., Nabela, D., Ilham, R., & Muliadi, T. (2022). The Capability of Village Devices in Stunting Prevention in Nagan Raya District. *Action Aceh Nutrition Journal*, *7*(1), 89. https://doi.org/10.30867/action.v7i1.759

Sultan, M. F. (2019). Pure Cross-Docking as Strategy of Distribution for Courier Services: A Quantitative Study on Perceived Benefits Associated With Inventory Cost. *Iel*. https://doi.org/10.7176/iel/9-4-02

Tadić, S., Mićić, B., & Krstić, M. (2023). Cross-Docking Concept: Role, Advantages and Disadvantages. *Tehnika*, *78*(6), 725–731. https://doi.org/10.5937/tehnika2306725t

Trejos, C. A. R., Meisel, J. D., & Jaimes, W. A. (2022). Humanitarian Aid Distribution Logistics With Accessibility Constraints: A Systematic Literature Review. *Journal of Humanitarian Logistics and Supply Chain Management*, *13*(1), 26–41. https://doi.org/10.1108/jhlscm-05-2021-0041

Vaismoradi, M., Jones, J. K. N., Turunen, H., & Snelgrove, S. (2016). Theme Development in Qualitative Content Analysis and Thematic Analysis. *Journal of Nursing Education and Practice*, *6*(5). https://doi.org/10.5430/jnep.v6n5p100

Varma, A. (2022). Encoding Structural Agility and Resilient Response Ability to Emergent Risks Within the Global Supply Chain. *JSCM*, *4*(3), 210. https://doi.org/10.69554/tvjk3444

Vega, D. (2018). Case Studies in Humanitarian Logistics Research. *Journal of Humanitarian Logistics and Supply Chain Management*, *8*(2), 134–152. https://doi.org/10.1108/jhlscm-01-2018-0005

Wang, F., Yuan, Z., Qin, S., Qin, F., Zhang, J., Mo, C., Kang, Y., Huang, S., Fang, Q., Jiang, J., Liu, A., Liang, H., & Ye, L. (2024). The Effects of Meteorological Factors and Air Pollutants on the Incidence of Tuberculosis in People Living With HIV/AIDS in Subtropical Guangxi, China. *BMC Public Health*, *24*(1). https://doi.org/10.1186/s12889-024-18475-0

Wang, J., Wen, J., Pajić, V., & Andrejić, M. (2024). Optimizing Cross-Dock Terminal Location Selection: A Multi-Step Approach Based on CI-DEA–IDOCRIW–MABAC for Enhanced Supply Chain Efficiency—A Case Study. *Mathematics*, *12*(5), 736. https://doi.org/10.3390/math12050736