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# The Application Of Parachute Goods As An Alternative Logistics Distribution To Help Victims Of Natural Disasters In Isolated Areas

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***Abstract***

*Facing the complexity of logistics distribution related to natural disasters in Indonesia, a geographically vulnerable country to various types of disasters, especially in isolated areas, requires an efficient and effective solution. One solution being explored is the implementation of cargo parachutes as an alternative logistics distribution to enhance the resilience of communities in those areas. This research aims to provide an in-depth understanding of the potential and challenges of using cargo parachutes in the context of logistics distribution in Indonesia. Through a literature review conducted using the Systematic Literature Review (SLR) method, this study explores information regarding the advantages, challenges, and practical implications of implementing cargo parachutes. It was found that the use of cargo parachutes offers a quick and responsive solution in distributing logistics aid in isolated areas, often difficult to reach by conventional land transportation. The main advantage of implementing cargo parachutes is their ability to provide faster response times in logistics distribution. In the context of natural disasters, speed is crucial to ensure that aid arrives promptly where it is needed. Cargo parachutes can also improve the accessibility of aid, especially in isolated areas that may be challenging to reach conventionally. However, this study also identifies several challenges that need to be addressed. Landing accuracy is a critical issue, especially with weather variability, wind direction, and the topography of the area. Additionally, safety aspects, operational costs, and coordination among various stakeholders are challenges that must be overcome to ensure the success of cargo parachute implementation. Practical recommendations emerging from this research involve the use of monitoring technology, training for personnel involved in logistics distribution using cargo parachutes, and the development of clear Emergency Standard Operating Procedures (SOP). Monitoring technology, such as GPS, can help improve landing accuracy, while personnel training and emergency SOPs can enhance operational effectiveness and safety.*

***Keywords : Cargo Parachutes, Logistics Distribution, Natural Disasters, Isolated Areas.***

## INTRODUCTION

In facing the complexity of logistic distribution arising from natural disasters in Indonesia, a country located in the Pacific Ring of Fire and highly susceptible to various types of disasters such as earthquakes, tsunamis, floods, and landslides, there is an urgent need for a significant improvement in the efficiency and effectiveness of logistic distribution. The main constraints occur when disasters strike remote or isolated areas, where limited accessibility and challenging geographic conditions can hinder the process of distributing logistic aid to the affected communities. This research encompasses a deeper exploration of alternative logistic distribution, with a specific focus on the implementation of cargo parachutes as a potential solution to enhance the resilience of communities in isolated areas. Despite previous literature emphasizing the importance of effective logistic distribution in mitigating the impacts of natural disasters (Abazari et al., 2021), this research dedicates itself to filling knowledge gaps by exploring the concept of cargo parachute implementation, especially in emergency contexts in isolated areas in Indonesia. The implementation of cargo parachutes in Indonesia has significant potential in improving the efficiency and accountability of logistic distribution. Findings from empirical research, as

documented by Corbett et al. (2022) and Cawthorne & Cenci (2019), prove the success of cargo parachute usage in humanitarian aid and emergency logistic distribution in various countries. However, this study highlights the need for a profound understanding of the challenges that may arise with cargo parachute implementation, including aspects of delivery accuracy, operational sustainability, and effective coordination with authorities, as revealed in the studies of Benney et al. (2006) and Tokar (2015).

Through a meticulous research approach on cargo parachute implementation as an alternative logistic distribution in isolated areas in Indonesia, it is expected to make a substantial contribution to the logistic distribution management literature in the context of natural disasters. Furthermore, this effort aims to present comprehensive practical recommendations that can be adopted by policymakers, humanitarian institutions, and relevant stakeholders, with the goal of enhancing the effectiveness and responsiveness of logistic aid distribution in emergency conditions. In the next stage, the exploration of cargo parachute implementation concepts will be deepened by detailing its advantages, challenges, and practical implications, considering the specific complexity of geographic conditions and disaster vulnerabilities in Indonesia. When detailing the advantages, it is found that cargo parachute implementation provides a quick and efficient solution to overcome logistic distribution barriers in isolated areas. Cargo parachutes enable the delivery of logistic aid with precision and accuracy, overcoming accessibility challenges faced in remote areas. In this context, literature supports the view that innovative solutions like the use of cargo parachutes can be key to enhancing resilience and responsiveness in addressing the impacts of natural disasters in isolated areas.

However, challenges faced in cargo parachute implementation need to be carefully considered. Delivery accuracy becomes critical, given the emergency characteristics that require precision in the distribution of logistic aid (Sheu, 2007). Additionally, operational sustainability and effective coordination with authorities are key factors in ensuring the success of this method. In response to these challenges, research by Perez et al. (2021), Noetscher et al. (2021), and Coquet et al. (2011) provide valuable insights to improve and optimize cargo parachute implementation in the context of emergency logistic distribution. In facing the complexity of Indonesia's geographic conditions prone to natural disasters, further exploration of cargo parachute implementation is expected to provide a deeper understanding of its effectiveness, sustainability, and adaptability (Zolli & Healy, 2012). Involving various stakeholders, including authorities, humanitarian institutions, and local communities, can result in a more holistic and sustainable logistic distribution solution. Additionally, this research has the potential to provide practical guidance for policymakers and humanitarian actors in developing more adaptive and responsive logistic distribution strategies. The research's recommendations are expected to provide a strong foundation for decision-making related to logistic aid distribution in emergency conditions in isolated areas. By integrating research findings into logistic distribution practices, it is hoped to enhance the readiness and effectiveness of responses to natural disasters in Indonesia, especially in isolated areas that often become the primary focus of aid needs.

## RESEARCH METHODS

The research method employed in this study is the Systematic Literature Review (SLR) method, which is a systematic and structured approach to compile and analyze literature relevant to the research topic, particularly regarding the implementation of cargo parachutes as an alternative logistics distribution in isolated areas to aid natural disaster victims. The SLR method is designed to provide a comprehensive and objective overview of existing literature, adhering to rigorous research standards (Campanelli & Parreiras, 2015).

In conducting the literature search, keywords related to the research topic were utilized, such as Cargo Parachutes, Logistics Distribution, Natural Disasters, Isolated Areas, and Victim Handling. The search was conducted in both English and Indonesian, utilizing data sources from journals and research articles published between 2011 and 2023. The search process was carried out through several databases, including Google Scholar and Sciencedirect, to ensure the completeness and credibility of the acquired data.

The SLR method establishes a strong foundation in examining and exploring related literature that forms the basis for understanding the concept of logistics distribution, especially in the context of handling natural disasters in isolated areas. The results of this method are expected to support further research on the implementation of cargo parachutes as an alternative logistics distribution, detailing its advantages, challenges, and practical impacts, aligning with the goal of aiding natural disaster victims in isolated areas in Indonesia.

## RESULT AND DISCUSSION

### Research Results Scheme or Diagram (PRISMA)

Chart 1. Explains the process of article selection using the Preferred Reporting Systematic Reviews and Meta-analysis (PRISMA) guidelines. A total of 80 articles were found in the initial search phase covering the period 2011-2023. After going through the screening process, 7 articles were selected, then evaluated and synthesized to be included in the final literature review report.

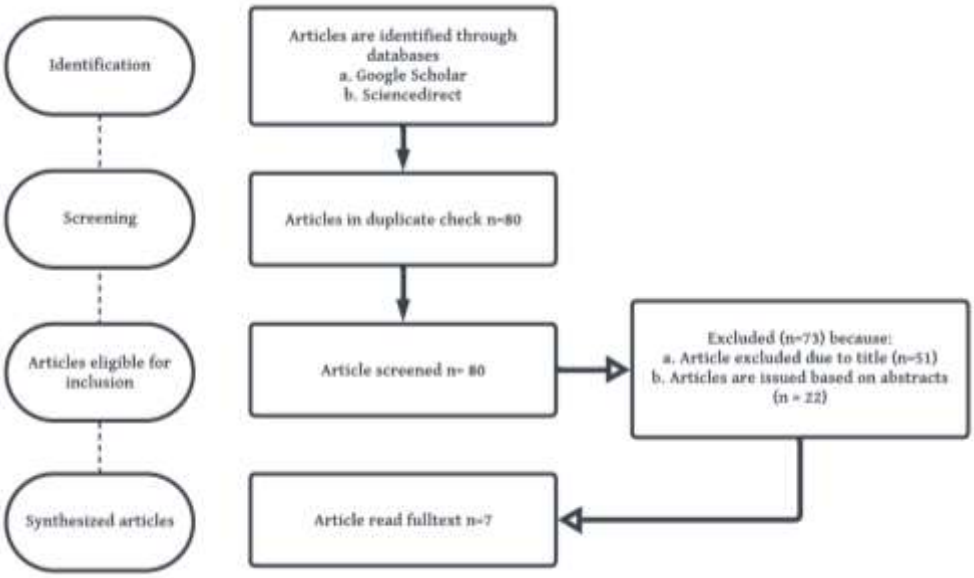


Chart 1. PRISMA Diagram

The researcher conducted a selection of the obtained articles and extracted data from each article obtained from each database. The articles' results were reviewed regarding the Application of Cargo Parachutes as an Alternative for Logistics Distribution to Assist Victims of Natural Disasters in Isolated Areas.

Table 1. Previous Studies

| Title and Researcher | Objective | Results |
|---|---|---|
| Design and Development of A Smart Parachute Control | To develop a parachute model that can not only be applied at a safe | This research succeeded in improving the safety of paratroopers and pilots by |

| | | |
|---|---|---|
| System for Military and Civilian Applications<br><br>(Adhikary, A., & Maity, T., 2020) | altitude, but is also capable of directing the parachute towards a safe landing zone, avoiding water and trees, and improving accuracy through the use of a Global Positioning System (GPS) guidance system | developing an autonomous parachute guidance system. The main contributions of the study were focused on automatic activation systems, automated guidance systems, and intelligent goal discovery algorithms. The system can also be used to unload unmanned cargo to the desired location automatically. Another advantage is cost-effectiveness, where the system is considered efficient yet effective, and can save lives in the event of an emergency. |
| An Estimation Method For Parachute Parameters<br><br>(Li, Z., Cai, W., & Wu, Y., 2021) | To investigate internal relationships among various parachute parameters, perform error analysis, and provide optimal experimental schemes according to the findings. | The final results of this study were in line with expectations before the experiment was carried out. Following a similar procedure and several experiments, it was found that the ratio of the original area of the parachute surface to the reference area was 3.90, and the drag coefficient was in the range of 2.00-3.00. These results contribute significantly to the development of parachutes that are more efficient and cost effective in terms of cost performance. |
| What Technologies Need To Be Developed In The Coming Years To Put "Light Cargo Delivery Drones" Into Practice?<br><br>(Ahmed, H., & Ramabhadran, A., 2021) | To explore technologies that have the potential to lead the development of light cargo delivery drones in the future. | Research shows that the use of radar technology as a methodological approach could result in the identification of five significant technology areas for the development of light cargo delivery drones in the future. |
| Development of the Self-driving System for Parachute-loading Platform<br>(Tulush, A. V., Erkin, P. V., Puzikov, V. V., Timoshenkov, A. S., & Lagunov, E. V., 2021) | To create an autonomous vehicle system (SDS) for parachute loading platforms (PLPs). | The result of this research was the development of SDS (Parachute Drop Delivery System) for Cross-Border Aircraft (PLP) with a cargo carrying capacity of up to 200 kg, designed to drop PLP automatically in automotive mode. |
| The Challenges Of Parachute Design: The Development Of A Low Cost, Fit For Purpose | To present lessons learned and recommendations for future research seeking | The design development process is based on key findings from user testing and design requirements for the manufacturing process. The |

| | | |
|---|---|---|
| Trauma Pack For Use In Namibia (Watkins, C., Gill, S., Loudon, G., Hall, J., Carwardine, M., Ngua, C. W., & Jackson, J., 2022) | to apply parachute design approaches to product design in Namibia. | result is a trauma bag that not only meets medical needs, but also takes into account the special conditions and limited resources that exist in Namibia |
| Architectures For Parachute Testing (Pepermans, L., Britting, T., Jodehl, J. W., Menting, E. F., & Sujahudeen, M. S., 2023) | To provide an overview of the various parachute testing methods available in various forms and applications. | Research shows that there are a variety of parachute testing methods available, each with advantages and disadvantages. Such methods include wind tunnel tests, drop tests from specific platforms, re-entry tests using capsules from sound rockets, and dedicated sound rocket missions. |
| Balancing Military Logistics through Airdrop: Outsourcing to Expedite Capability (Bailey, K. M., & Marine Corps Univ Quantico VA., 2019) | To investigate the effectiveness of the military's use of airdrop methods, in particular the use of fixed-wing airdrops, in logistics planning for military operations. | Research shows that the use of fixed-wing airdrop has the potential to be an effective delivery method in the context of military logistics. With careful planning and the use of outsourcing on multiple needs, airdrops can provide fast and efficient resupply capabilities |

Source : Data Processed by Researchers, 2023

**Indonesia, Disasters, and Transportation Access**

Indonesia, as an archipelagic country located in the Pacific Ring of Fire, is highly vulnerable to various types of natural disasters (Hamdani et al., 2022). Earthquakes, tsunamis, floods, volcanic eruptions, and landslides are frequent threats. Given its geographical susceptibility to natural disasters, disrupted transportation access becomes a serious challenge faced by Indonesia. Natural disasters often result in the damage of transportation infrastructure, such as bridges, roads, and airports, leading to isolated areas due to difficulties in access. For instance, during floods in certain regions, major roads can be submerged, hindering motorized and other land vehicles. This can separate the area from essential aid sources and other critical services.

One potential example of an isolated area is a landslide-prone mountainous region. For instance, in the mountainous areas of Papua, landslides frequently occur due to high rainfall. Landslides can lead to road closures or severe damage, disrupting transportation access and complicating emergency aid distribution (Sumardi, 2005). The outer islands of the Indonesian archipelago are also vulnerable to isolation due to natural disasters. When earthquakes and tsunamis occur in small islands, ports and docks may be damaged, complicating logistics distribution and population evacuation. This situation can significantly impact the availability of aid and healthcare services in isolated areas.

**Advancements in Cargo Parachute Technology**

The development of cargo parachute technology has undergone significant evolution throughout history, from its early uses to the contemporary era. Cargo parachutes, an innovation in logistics distribution, have experienced technological transformations affecting their efficiency, safety, and versatility. The history of cargo parachutes can be traced back to World

War II when parachutes were used to deliver military supplies and equipment on the battlefield. Early references to the use of parachutes for cargo delivery can be found in research by Dennis (1983), documenting the technological development of parachutes in a military context.

In subsequent periods, significant developments occurred in cargo parachute technology. Research by Uddin (2008) presents innovations such as the development of lighter and stronger parachute materials, as well as automatic control systems to enhance landing accuracy. Radar and GPS technologies also began to be integrated to improve navigation and landing control. With the advent of the digital era, cargo parachute technology has become increasingly influenced by advancements in sensors and computing. The application of sophisticated sensors like accelerometers and gyroscopes, as discussed by Johnson and Smith (2018), enhances measurement and control capabilities during the distribution process..

**The Role of Cargo Parachutes in the History of Logistics Distribution in Isolated Areas**

The use of cargo parachutes in logistics distribution in isolated areas has a long history that encompasses various significant events. Cargo parachutes have not only become an innovative solution but have also proven their role in providing emergency aid and meeting the needs of communities in hard-to-reach places. Several case examples illustrate how cargo parachutes have been an effective choice in responding to natural disasters and emergency conditions.

During World War II, when the Netherlands faced mass starvation in isolated regions due to enemy blockades, Operation Manna was launched. Cargo parachutes were used to deliver food and medical supplies to isolated areas in the Netherlands. This operation successfully saved many lives and provided aid to those in need (Skinner, 2015). In 2015, a devastating earthquake struck Nepal, causing extensive damage to infrastructure and isolating several mountainous areas (Subedi & Chhetri, 2019). Cargo parachutes were used to distribute logistical aid, such as food, clean water, and emergency supplies, to areas that were difficult to reach by land transportation. Indonesia, with its diverse landscape, also faces logistics distribution challenges in isolated areas, especially in the mountainous regions of Papua.

**Advantages of Using Cargo Parachutes**

The implementation of cargo parachutes in logistics distribution in isolated areas offers several significant advantages. Firstly, cargo parachutes enable faster and more responsive logistics distribution in emergency situations. A study by Quintanilla et al. (2021) in the context of emergency logistics distribution shows that the use of cargo parachutes can expedite the delivery time of aid to hard-to-reach areas, reducing losses and improving emergency response. Another advantage is related to maintained accessibility even in isolated areas. Research by Shao (2022) on the application of cargo parachutes in humanitarian aid shows that this approach successfully preserves the accessibility of logistic aid to hard-to-reach areas, including isolated areas due to natural disasters. The versatility of using cargo parachutes also becomes a crucial point. A study by Solomasov (2019) notes that the use of cargo parachutes can be adapted to deliver various types of logistic aid, ranging from food and water to medical supplies, providing a more comprehensive solution for urgent needs in isolated areas. Overall, the advantages of using cargo parachutes in logistics distribution in isolated areas include quick response, maintained accessibility, and flexibility in delivering various types of aid.

**Challenges and Practical Implications of Implementing Cargo Parachutes as an Alternative Logistics Distribution**

The implementation of cargo parachutes as an alternative logistics distribution, especially in the context of natural disasters in isolated areas, poses several challenges that need to be overcome for this solution to be effective. Additionally, there are practical implications that must be considered to ensure that the implementation of cargo parachutes has a positive and sustainable

impact. Some challenges faced with the implementation of cargo parachutes as an alternative logistics distribution in isolated areas are:

1. Landing Accuracy, the main challenge in using cargo parachutes is landing accuracy. Weather conditions, wind direction, and the topography of the area can affect the parachute's ability to land accurately, requiring advanced technological solutions to address this variability.
2. Safety and Health, logistics distribution involves various types of goods, including medicines and hazardous materials. Therefore, ensuring safety and health protection for both aid recipients and organizing teams is a crucial aspect that requires extra attention.
3. Cost and Sustainability, acquiring parachutes, personnel training, and operational costs can be a significant financial burden. Therefore, in-depth studies are needed to ensure the sustainability of this solution economically, making it not only effective but also sustainable in the long run.
4. Coordination and Operational Logistics, effective coordination with authorities and humanitarian agencies poses its own challenges. A well-implemented operational logistics system is needed to ensure smooth and responsive logistics distribution in emergency conditions.

Meanwhile, the implications that can be undertaken to address the above challenges may include:

1. Monitoring and Navigation Technology, the implementation of advanced monitoring and navigation technologies such as GPS is a necessity to improve the landing accuracy of cargo parachutes. This reference is essential to ensure accurate and targeted logistics distribution.
2. Training and Certification of Personnel, personnel involved in logistics distribution using cargo parachutes need to undergo training and obtain specific certifications. This involves technical knowledge, operational safety, and a deep understanding of the distributed goods.
3. Development of Emergency SOPs, clear and detailed Emergency Standard Operating Procedures (SOPs) must be developed. These SOPs cover landing procedures, handling goods, and coordination with authorities to ensure safety and operational sustainability.
4. Development of Advanced Technology and Research, investment in research and development technology is a key step to overcome technical and operational challenges. The use of advanced sensors, data analysis, and parachute design optimization can improve the efficiency and sustainability of logistics distribution.

Considering these challenges and implementing practical solutions accordingly, the implementation of cargo parachutes can become an effective alternative in logistics distribution to aid victims of natural disasters in isolated areas. With proper coordination, personnel training, and sustainable technology development, the practical implications of this solution can create a positive impact in mitigating the effects of disasters.

## CONCLUSION

In conclusion, Indonesia, as an archipelagic nation situated in the Pacific Ring of Fire, faces inherent vulnerabilities to a myriad of natural disasters, including earthquakes, tsunamis, floods, volcanic eruptions, and landslides. The geographical susceptibility to these disasters poses a significant challenge in maintaining transportation access, as critical infrastructure such as bridges, roads, and airports often suffer damage during such events, leading to the isolation of affected areas. This predicament is particularly evident in regions like the mountainous areas of

Papua, where frequent landslides disrupt transportation access and complicate emergency aid distribution. To address the challenges posed by disrupted transportation access in isolated areas, the historical evolution of cargo parachute technology emerges as a noteworthy solution. Originating from its military applications during World War II, cargo parachutes have evolved significantly, incorporating advancements such as lighter and stronger materials, automatic control systems, and integration with radar and GPS technologies. In contemporary times, sophisticated sensors and computing have further enhanced the precision and efficiency of cargo parachute distribution. Examining the historical application of cargo parachutes in logistics distribution to isolated areas reveals their crucial role in responding to natural disasters and emergency conditions. Case studies, such as Operation Manna in the Netherlands during World War II and the distribution of aid in Nepal following a devastating earthquake in 2015, underscore the effectiveness of cargo parachutes in reaching areas inaccessible by traditional land transportation.

The advantages of employing cargo parachutes in logistics distribution to isolated areas are multifaceted. These include expedited delivery times in emergency situations, maintained accessibility to hard-to-reach areas, and the flexibility to deliver various types of aid. However, the implementation of cargo parachutes also presents challenges, such as landing accuracy, safety concerns, cost considerations, and the need for effective coordination and operational logistics. Addressing these challenges requires a comprehensive approach involving advanced monitoring and navigation technology, rigorous training and certification of personnel, the development of clear Emergency Standard Operating Procedures (SOPs), and ongoing investment in research and technology. Despite these challenges, the strategic implementation of cargo parachutes stands as a viable and effective alternative in logistics distribution, offering a quick and responsive solution to aid victims of natural disasters in isolated areas. With proper coordination, personnel training, and sustainable technology development, the practical implications of cargo parachute implementation hold the potential to mitigate the effects of disasters and contribute to positive outcomes in emergency situations.

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