An Exploratory Factor Analysis on the Structural and Operational Factors in Agri-Business Last-Mile Logistics in Davao City

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ABSTRACT

Last-mile logistics is an integral and key component of agribusiness supply chain which influences the efficient and reliable customer delivery while facing various structural and operational challenges in an urban setting. The study aims to ascertain the underlying factors that influence agribusiness last-mile logistics. It employs Exploratory Factor Analysis (EFA) where the data was gathered from 280 agribusiness retailers located in six key public markets in Davao City using both cluster and random sampling. The data was analyzed using principal component analysis extraction method and varimax rotation method with kaiser normalization. The results showed that four key drivers of logistics related challenges in the agribusiness industry, including collaborative digital logistics capability, institutional and policy support, environmental sustainability and waste control, and transport infrastructure and disruption resilience. The findings highlight two novel findings which includes that logistics challenges in agri-business is multidimensional and contextually, the study also indicates that regardless of the size of the organization, the strategic importance of digital collaboration influences last-mile logistics in agri-business.

Keywords: Agri-business Logistics, Agri-business Retail, Exploratory Factor Analysis, Digital Logistics, Last-Mile Logistics, Supply Chain Sustainability, Infrastructure Resilience, Logistics, SDG2, SDG8, SDG9. SDG,12

INTRODUCTION

The last-mile logistics plays a fundamental role in the supply chain specifically in ensuring the efficient movement of goods. In the agribusiness industry, it is critical in the movement of agricultural products from producers to consumers, similar to many industries yet its effectiveness is often constrained by complex structural and operational challenges. These challenges is marked by numerous barriers that directly and indirectly impact the efficiency and success of the sector. Globally, these challenges include the structural challenge of inadequate infrastructure that hinders market access and increases transportation costs, particularly in rural areas (Sacramento 2021, Hussain & Guha 2023). Timely delivery is likewise often impeded by inefficient road networks and poor logistical coordination, leading to delays and higher costs for agri-business retailers (Kuteyi & Winkler 2022). In addition, sustainability concerns have increasingly become a central issue, with agri-businesses struggling to meet consumer demands for eco-friendly and socially responsible practices, particularly concerning food safety and waste management (AminChaudhry et al., 2022 & Boskova et al., 2024). These interconnected issues, exacerbated by inadequate infrastructure and unsustainable practices, negatively affect agribusiness performance, hindering profitability and market competitiveness.

The Philippine economy considers agribusiness as one of the fundamental pillars. It contributes significantly to food security and employment specifically, and the national economic development in general. Today, the Philippine economy has increasingly become more service-oriented, however, the agribusiness sector continues to play a strategic role. Recent data provided by the Philippine Statistics Authority (PSA) shows that the sector is contributing approximately 8–9% of the Philippine Gross Domestic Product (GDP). Moreover, millions of Filipinos are employed in the agribusiness sector, making it one of the largest employment-generating sectors in the country (PSA, 2025; PSA, 2026). Furthermore, the Philippine Medium-Term Development Plan (PDP)

2023–2028 recognizes it as a key national development priority to achieve inclusive economic growth and rural transformation (NEDA, 2023). However, despite its strategic importance, it continues to face structural constraints and operational challenges which significantly constrain the productivity and global competitiveness of the Philippines (Briones, 2021).

Last-mile logistics, structurally has become one of the critical components of modern supply chains. In a growing customer-centric environment, it directly determines whether products reach customers in a logistics perfect order (LPO) manner. It various sectoral setting, it is often considered as the most costly operations, complex, and service-sensitive part of the supply chain. This is due to the transportation variability, delivery scheduling challenges, and infrastructural constraints (Olsson et al., 2019; Lagin et al., 2022). This is on top of the ever increasing and sophisticated customer expectations. These challenges are even more pronounced in agribusiness as agricultural commodities are intrinsically perishable and require rapid and reliable distribution systems. This is to ensure the preservation of product quality, minimization of spoilage, and ensure the food safety. An inefficient last-mile logistics is a contributor to high transportation costs, faster product deterioration, and delayed deliveries ultimately leading to reduced profitability among supply chain participants (Naik & Suresh, 2019).

The significance of the last-mile logistics is particularly evident in the Philippines, where geographic fragmentation poses unique distribution challenges. As an archipelagic country with more than 7,600 islands, the movement of agricultural products frequently requires multimodal transportation involving road, sea, and, in some cases, air transport before reaching retailers or consumers. Variations in transportation infrastructure, traffic congestion, limited cold-chain facilities, and vulnerability to natural disasters further increase logistics costs and delivery uncertainty. Recognizing these challenges, the National Economic and Development Authority (NEDA) identified logistics modernization, digital transformation, transport connectivity, and supply chain resilience as major priorities under the Philippine Development Plan 2023–2028 to strengthen food security, improve market efficiency, and reduce regional development disparities (National Economic and Development Authority [NEDA], 2023). Likewise, the Philippine Statistics Authority (PSA) has consistently highlighted the importance of improving agricultural value chains and logistics systems to enhance agricultural productivity and reduce post-harvest losses (Philippine Statistics Authority [PSA], 2025).

Similarly, international studies emphasize that resilient infrastructure, digital logistics technologies, and integrated supply chain coordination are essential for ensuring agribusiness continuity, particularly during periods of economic disruption and climate-related crises (Dobrodomova et al., 2020; Md. Aktar Hussain & Guha, 2023; Kuteyi & Winkler, 2022). Studies revealed that beyond operational efficiency, sustainability has become a strategic priority for agribusiness organizations worldwide. Modern agricultural supply chains are increasingly expected to balance economic performance with environmental stewardship and social responsibility. Sustainable logistics practices, including optimized transportation routes, collaborative distribution, digital traceability, reduced food waste, and environmentally responsible operations, have become integral components of competitive agribusiness systems (Amin-Chaudhry et al., 2022; Testa et al., 2022). Likewise, sustainable agri-retail supply chains require stronger collaboration among farmers, logistics providers, distributors, retailers, and government agencies to improve resilience while minimizing environmental impacts (Naik & Suresh, 2019; Slamet et al., 2020). Consumer preferences have likewise shifted toward fresher, safer, and sustainably sourced food products, compelling agribusiness firms to redesign their logistics systems to satisfy increasingly demanding market expectations (Ehgartner, 2018).

Several studies revealed that there are several dimensions behind the logistics challenges faced by agri-business retailers, cutting across infrastructure, last-mile logistics, and sustainability domains. The study by Hussain and Guha (2023) highlighted how inadequate farm storage facilities, lack of agro-processing units, and limited access to regulated market facilities weaken resilience during crises. Moreover, Dobrodomova et al. (2020) added that limited financing access, high loan interest rates, complex tax regulations, and a lack of entrepreneurial knowledge are compounded by weak regional support institutions. In the study by Hermoso et al. (2021) and Kuteyi and Winkler (2023), the authors emphasized the importance of physical infrastructure, pointing to poor road conditions, insufficient bridges, unreliable electricity supply, and high transport costs, which ultimately lead to significant post-harvest losses. The authors Ren et al. (2023) and Ordoñez (2017) also stressed the need

for digital infrastructure and better farm-to-market roads, while Sacramento (2021) highlighted how limited rural transportation, insufficient storage, and high input costs erode competitiveness.

In the area of last-mile logistics, Olson et al. (2019) identify]ied operational inefficiencies and weak supply chain structures, while Bertolini et al. (2024) and Guiffrida et al. (2022) pointed out to urban congestion, road safety, and the underuse of machine learning in logistics. Melkonyan et al. (2020), Nguyen et al. (2025), Lagin et al. (2022). In addition, Fried and Goodchild (2023) highlighted the poor coordination, weak omnichannel integration, and uneven logistics platform locations as critical bottlenecks. Finally, on the sustainability front, Amin-Chaudhry et al. (2022) pointed to water shortages, labor issues, and supply chain pressures, while Slamet et al. (2020), Ehgartner (2018), whileTesta et al. (2022) emphasized weak physical infrastructure, lack of sustainable innovation, and poor circular economy links. Similarly, Royer and Simon (2023), Naik and Suresh (2018), and Boskova et al. (2024) highlighted small producers' low bargaining power, weak farmer-retailer integration, and the absence of clear sustainability benchmarks, further complicating the path toward resilient and efficient agri-business operations.

A review of the existing literature reveals several important gaps that this study aims to address. First, there is a limited focus on regional contexts, particularly in areas like Davao City, where agricultural and logistical dynamics may differ significantly from national or international settings (Hussain & Guha, 2023; Sacramento, 2021). Most studies explore broad trends without considering local challenges that impact agribusiness retail logistics performance. Second, there is an insufficient integration of last-mile logistics and sustainability. While Bertolini et al. (2024) and Nguyen et al. (2025) examine these topics separately, few studies explore how sustainable practices can be embedded within last-mile logistics strategies specifically for agri-business retailers. Third, the literature shows a lack of empirical research directly linking logistical activities to agri-business retailer performance outcomes, such as profitability and customer satisfaction, with most studies (Hermoso et al., 2021; Ordoñez, 2023) focusing instead on broader agricultural infrastructure concerns. Fourth, although the importance of digital innovations in logistics is increasingly recognized (Ren et al., 2023; Melkonyan et al., 2020), there remains a research gap in the adoption of technology, particularly digital infrastructure and automation within agri-business retail logistics. Finally, while infrastructure issues such as poor road conditions and insufficient storage are well-documented (Kuteyi & Winkler, 2023; Dobrodomova et al., 2020), there is limited research examining how specific infrastructure components impact the operational efficiency and performance of agribusiness retailers. Addressing these gaps provides localized, practical insights for improving retail logistics performance and help agri-businesses thrive in a competitive and sustainability-driven marketplace.

Despite the growing studies on agricultural logistics, relatively few studies have examined the underlying structural and operational dimensions of last-mile logistics within the Philippine agribusiness context. Existing studies frequently evaluate individual operational indicators such as transportation efficiency, delivery performance, infrastructure, warehouse operations, or inventory management without empirically identifying the latent constructs that collectively explain logistics performance. Given the complexity of agribusiness logistics systems, understanding these underlying dimensions is necessary for developing evidence-based interventions, improving resource allocation, strengthening supply chain resilience, and supporting national food security initiatives.

This study directly aligns with and contributes to several United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 12 (Responsible Consumption and Production). By examining the impact of infrastructure, last-mile logistics, and sustainability practices on agri-business retail logistics performance, the research addresses food security challenges through improved efficiency and reduced post-harvest losses (Hussain & Guha, 2023; Sacramento, 2021). Enhancing logistical performance promotes economic resilience among small and medium-sized agri-retailers, supporting inclusive economic growth (Dobrodomova et al., 2020; Ordoñez, 2023). By emphasizing the role of infrastructure development and sustainable last-mile practices (Bertolini et al., 2024; Nguyen et al., 2025), the study supports the creation of innovative, sustainable systems necessary for robust supply and retail networks. Encouraging better logistics and eco-friendly distribution strategies aligns with responsible production goals and helps establish long-term

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practices that protect both the environment and livelihoods (Melkonyan et al., 2020; Ren et al., 2023). Through localized insights from Davao City's agri-business sector, the study contributes to the global agenda of building resilient, sustainable, and inclusive food and economic systems.

To address this gap, the objective of the study is to determine the underlying factor structure of the structural and operational factors affecting agri-business last-mile logistics in Davao City through Exploratory Factor Analysis. More specifically, it examined the suitability of the collected data for factor analysis. Once determined, it extracted the latent factors underlying the observed structural and operational indicators of agri-business last-mile logistics. Likewise, it determined the factor loadings and communalities of the retained indicators. Finally, it helped interpret and label the extracted factors based on the conceptual relationships among the retained variables.

Theoretical Framework. This study is anchored on various interrelated theoretical perspective which explains the multidimensionality of agri-business last-mile logistics. First, it is anchored on the Supply Chain Management Theory by Christopher (2016) and also advanced by Mentzer et al. (2001). It views supply chains as interconnected framework and a system of organizations, resources, information, and processes. All these elements work together to deliver products efficiently to consumers. Another theory is the Logistics Management Theory of Bowersox et al. (2019). The theory highlighted the need for strategic coordination among the supply chain elements of transportation, warehousing, inventory, and distribution. These activities, together help achieve operational efficiency and customer value. The study is likewise anchored on the Resource-Based View (RBV) theory proposed by Barney (1991). The author explained that organizational resources and capabilities, including logistics infrastructure, transportation assets, digital technologies, and skilled personnel. All these constitute the strategic resources which influences logistics performance. Furthermore, the study is also anchored on the Transaction Cost Economics (TCE) theory espoused by Williamson (1985). It provides a lens for understanding the coordination mechanisms, governance, and collaboration that is required among supply chain actors.

Moreover, the study is also anchored on the Network Theory by Håkansson and Snehota (1995). The theory conceptualizes supply chains as a network of suppliers, producers, distributors, and retailers including logistics providers, government agencies, and consumers. The relationships that exist among them influence the entire operational effectiveness. Likewise, the study takes consideration of the propositions of the Socio-Technical Systems Theory as introduced by Trist and Bamforth (1951) and further developed by Emery and Trist (1965). The authors explained that successful systems are dependent on the interaction between the technological infrastructure and the organizational processes. The authors likewise highlighted the strategic importance of digital logistics as it is utilized to improve, human competencies supported by institutional support. Finally, the study is also informed by the Resilience Theory by Christopher and Peck (2004) and Ponomarov and Holcomb (2009). The authors posits that the capability of logistics systems help companies to anticipate, absorb, adapt to, and recover from disruptions. Collectively, the theories provide a comprehensive understanding of the conceptual foundation to identify the latent structural and operational factors of agri-business last-mile logistics.

METHODOLOGY

This study is utilizing a quantitative research design where it uses the Exploratory Factor Analysis (EFA) as the primary statistical technique. The study aimed to identify the underlying dimensions of structural and operational factors influencing agri-business last-mile logistics in Davao City. As such, EFA is an appropriate method to meet the objective of the study (Hair et al., 2019; Costello & Osborne, 2005; Fabrigar et al., 1999). Previous studies reviewed identified various dimension affecting agricultural logistics in the context of last-mile distribution. Consequently, EFA ensures a rigorous data reduction as well as construct identification which enabled the development of a measurement framework as it uncovers the latent dimensions.

Research Respondent. The respondents of the study are Davao City-based Agribusiness Retailers. Fruits, vegetables, cereals, farm inputs, and processed commodities are among the agricultural products that these retailers sell and distribute. They are essential in linking local farmers with marketplaces and consumers both inside and outside the area. The study comprised with a representative sample of agribusiness retailers, taking

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into account both small- and medium-sized enterprises, in order to gather pertinent and context-specific insights. In Davao City, there are roughly 280 registered agribusiness retailers, to local government data and public documents. Using suitable selection techniques, a predetermined number of respondents were chosen from this demographic in order to guarantee a range of viewpoints and accurate data gathering for the study.

Instrument. The main research instrument used in this study is a structured questionnaire, designed to collect quantitative data on the root causes of logistics challenges faced by agri-business retailers, specifically related to infrastructure, last-mile logistics, and sustainability. The questionnaire was developed based on an extensive review of the literature to ensure content validity. Studies such as Hussain and Guha (2023), Dobrodomova et al. (2020), Kuteyi and Winkler (2023), Olson et al. (2019), and AminChaudhry et al. (2022) provided the theoretical foundation for identifying key variables and dimensions.

The questionnaire consisted of three main sections. The first section gathered the demographic profile of respondents, including age, sex, years in the business, and type of operation, following standard practices for descriptive profiling (Zikmund et al., 2010). The second section measured infrastructure, last-mile logistics, and sustainability challenges using 40 items drawn from the root causes identified in the literature, such as poor road conditions, inadequate storage, weak coordination among logistics players, and limited sustainability innovation. These items were assessed using a 5-point Likert scale, ranging from 1 (“Strongly Disagree”) to 5 (“Strongly

Agree”), following recommendations by DeVellis (2017) for measuring perceptions and attitudes in organizational research.

Sampling Method. The study utilized cluster and random sampling method. The authors Etikan et al. (2016) reported that this probability method provides all the members of the target population with an equal, independent probability of selection and reduces the prejudice and increases the generalizability of the results. The sampling frame was drawn by using a sample of around 280 registered agribusiness retailers in Davao City (local government data, 2023). The participants were chosen at random by the use of a random number generator; this guaranteed the representation of the business types, locations, and sizes (Taherdoost, 2016). Moral implications were taken into account, and the respondents could leave or drop out of the study at any time (Israel and Hay, 2016). A sample of 200-400 participants (5-10 respondents per variable) was intended in accordance with Hair et al. (2019) to guarantee the good level of extraction of factors.

Data Gathering Procedure. The data gathering process followed these steps. Before the data gathering process begins, the researchers noted ethical considerations for the privacy and safety of their participation. The researchers asked the participants to sign the Informed Consent Form (ICF) which contains how the data is used in the study as well as their rights. For the interview, the researchers discussed with the participants their main role in the study. Once the participants sign the consent form, the data gathering started.

The interviews followed. According to Creswell & Poth (2018), the number of participants in a qualitative study, specifically for in-depth interviews, for phenomenological studies, the recommended number is 5 to 25 participants; for grounded theory or depending on the study design and the point of data saturation. In the study the purpose of the interview is to gather expert opinion on the topic. During the interviews, the researchers took audio recording. The researchers used the recordings for the transcription to code it and used to create the survey questionnaire. used for the scale development for the Exploratory Factor Analysis. The survey questionnaire was then used for the conduct of the EFA survey.

The researchers ensured the privacy of the participants and the data is well kept and well regulated in accordance with the Data Privacy Act of 2012 wherein it states that the data of the participants nor their information shall not be exposed to the public. The researchers also made the statement regarding their interpretation of data while maintaining fairness and integrity.

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RESULTS AND DISCUSSION

This section presents the results and discussion. The first part presents the demographic profile of the 280 respondents followed by the KMO and Bartletts test to ensure there is a reason to use exploratory factor analysis. Then, the presentation of the factor loading and rotation, the conclusion, and recommendations.

Demographic Profile

Table 1. Type of Business

Type of Business	Banke-rohan	Panacan	Toril	Tibungco	Agdao	Total	%age
Vegetable Retailers	21	5	16	2	15	59	21.10%
Fruits Retailer	19	8	10	8	10	55	19.60%
Agri Sari-Sari Store	8	12	10	8	9	47	16.80%
Meat & Poultry Retail	10	10	6	5	5	36	12.90%
Fish & Seafood	3	5	7	3	3	21	7.50%
Rice & Grain Retailer	8	4	-	3	3	18	6.40%
Wholesaler of Agri-Products	1	6	5	3	3	18	6.40%
Mixed Agr-Products	-	1	9	1	2	13	4.60%
Agri-Supply Business	-	3	2	-	-	5	1.80%
Processed Agri Foods	-	3	2	-	-	5	1.80%
Farm producer	-	-	2	-	-	2	0.70%
Others	-	-	1	-	-	1	0.40%
Total	70	57	70	33	50	280	100.00%

Table 1 gives the demographic profile of the agri-business respondents based on type of business and geographical area in the prime market locations of Davap City that includes Bankerohan, Panacan, Toril, Tibungco and Agado, and a sample population of 280 respondents. The findings show that the largest proportions of traditional locations are vegetable retailers (21.1) and fruit retailers (19.6), then agribased sari-sari stores (16.8) and meat and poultry retailers (12.9). It brings out the preeminence of fresh and highly perishable items in the agri-retail setting of Davao City.

Moreover, the Bankerohan and Toril have the largest numbers of respondents (70 and 70, respectively), as they are major trading and redistribution centers, whereas Panacan, Tribungco, and Agdao are small secondary market places that facilitate locally-based last-mile delivery. The significance of this geographically disaggregated demographic profile is that the logistics issues vary depending on the type of business and the location of the business where perishable-oriented retailers are more vulnerable to delays during their transportation. The

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quality of infrastructure, weather inconveniences, variations in market density and access are different across the districts. It affected the coordination practices, the frequency of restocking, and sustainability behaviors. This means that the population distribution by the geographical location is a crucial background of the EFA outcome to provide an answer to the factors that are seen to be the underlying determinants of the logistics problem facing the agri-business retailers in Davao City.

Table 2. Years in Operation

Years in Operations	Banke-rohan	Panacan	Toril	Tibungco	Agdao	Total	%age
0-5 years	47	15	20	16	20	118	42.10%
6-10 years	10	17	6	12	5	50	17.90%
11-15 years	2	6	15	1	17	41	14.60%
16-20 years	3	1	3	1	5	13	4.60%
> 20 years	8	3	26	12	9	58	20.70%
Total	70	42	70	42	56	280	100.00%

Table 2 shows the number of agri-business retailers in years of operations in the key market locations of Davao City particularly Bankerohan, Panacan, Toril, Tibungco and Agdao, with the total respondents of 280 agri-business retailers. The findings indicate that a high percentage of firms has been in operation since 05 years and above (42.1%), which means that there are a lot of new and quite young firms in the agri-retail sector of Davao City. This trend indicates one of the active yet possibly unstable groups of retailers that might not have fixed well-developed supply chains, logistics, and sustainability yet. Meanwhile, a good portion of the respondents operate over 20 years (20.7%), which is especially high in Toril and Tibungco, which indicates the existence of adult businesses with established logistics processes and more established business ties in the market. The other respondents will fall under the 6-10 years and 11-15 years categories at 17.9 and 14.6 percent, respectively, which are in the mid-stage of operation and are most likely to be on the transition stage of informal to formal logistics and operations systems.

This demographic factor is significant since years of operation are determinant of logistic behavior, resilience, and adaptability whereby younger companies might have more difficulty in terms of access to infrastructure, coordination, and capital, whereas older companies might experience more access to experience, pre-established supplier networks, and adaptive approaches to endure transport shocks, and market uncertainty. Therefore, the difference in the term of operations of the different locations is crucial to interpreting the EFA outcome in that it aids in understanding why the agribusiness retailers in Davao City are exposed to different challenges of the last-mile logistics, infrastructure limitations, and sustainability practices.

Among the 280 respondents, there were 51 agri-business retailers distributed all over the market areas of Bankerohan, Panacan, Toril, Tibungco, and Agdao in Davao City. The findings show that the industry is preponderantly characterized by micro-sized firms, 79.3% of which have 0-9-workers, which are indicative of the small-scale and labour light form of agri-retail business in Davao City. This is trail by firms with 10-20 (15.0%) workers followed by a very small percentage with 20-100 (3.6%), over 100 workers (2.1), which indicates the small number of medium to large agri-business enterprises.

The importance of this demographic trait is based on the fact that the size of firms directly influences the logistics ability, access to infrastructure and sustainability practices. Small and micro businesses tend to have a higher exposure to last-mile, transport delays, infrastructure shortages, and lack the capacity to invest in cold storage, technological logistic solutions, or sustainability systems, whereas they tend to be more susceptible to the problem of the last-mile, transport delays, and infrastructure insufficiency. On the other hand, the small number of larger companies are better placed to have organized logistics planning, full-time employees and are more likely to withstand the impact of shocks. The insight into the majority of micro-sized enterprises consequently

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forms an invaluable background in understanding the EFA outcome, given its ability to inform the reasons behind the apparent impact of factors associated with coordination efficacy, infrastructure resilience, and sustainability practices as the primary factors of logistics issues among agri-business retailers in Davao City.

The distribution of the agri-business retailers in Davao City shows the ownership of transport vehicles in Bankerohan, Panacan, Toril, Tibungco and Agdao with the total number of respondents being 280. The findings reveal that the majority of the retailers are the owners of transport vehicles (68.2%), whereas a big proportion (31.8) is not and, instead, uses third-party transport services, the shared logistics, or informal delivery arrangements. This trend shows how significant the transport ownership as a coping mechanism in the environment is when the overall infrastructure of the transport logistics and the institutionalized last-mile services are unevenly distributed. As per past studies, vehicle ownership would bring significant reliability to last-mile, flexibility of delivery, and control of logistics expenses, particularly when it comes to small agri-retailers dealing with perishable goods (Lagin et al., 2022; Olsson, Hellström, and Pålsson, 2019).

In terms of sustainability and resilience, ownership of transport also implies the adaptivity behavior of small agri-businesses whose work targets the infrastructure constrained environment. In the articles by Kuteyi and Winkler (2022) and Giuffrida et al. (2022), the authors pointed out that the internalization of the logistics functions such as transport is common in the emerging economies because of the lack of access to cheap and trusted third-party logistics firms. This is in agreement with other researchers in the Philippine context such as Briones (2021) and Hermoso et al. (2021) who pointed out that the lack of transport infrastructure and logistics services is forcing retailers to use self-managed delivery mechanisms. Nevertheless, the vehicle ownership enhances the operational autonomy, but it might also exert more environmental pressures due to more emissions and discontinuous delivery paths, which strengthen the sustainability issues raised by Amin-Chaudhry, Young, and Afshari (2022) and Testa et al. (2022).

The average monthly sales agri-business retailer level of Bankerohan, Panacan, Toril, Tibungco and Agdao, in Davao City using 280 respondents, and demonstrates the largely small scale and revenue bound nature of agri-retail operations in Davao City. The highest percentage of the respondents is in the bracket of php10,000-php50,000 (38.2%), then 29.3 percent in the bracket of 25,000-100,000, and a small percentage of 13.6 percent in the bracket of sales more than 100,000/month. This distribution means that the majority of agri-business retailers are run on a small financial margin, and this directly limits their ability to invest in logistics hardware, digital capabilities, cold storage, and innovations that are aimed at sustainability.

This sales profile plays an important role in the interpretation of logistics issues since financial capacity is an important factor in the performance of last-mile and resilience. Agri-retail and last-mile logistics studies are more focused on asserting that low-revenue companies are more susceptible to the change in transport costs, infrastructure inefficiencies, and supply-related disruptions, especially when operating in the context of perishables (Lagin et al., 2022; Olsson, Hellström, and Pålsson, 2019). In the Philippine environment, Briones (2021) and Hermoso et al. (2021). On the same note, agri-businesses that operate on a small scale are usually ill equipped to absorb shocks in the logistics sector by small profit margins and lack of access to the formal financing. Besides, sustainability studies note that although small retailers might have the desire to go green, they are frequently prevented by financial resources (Amin-Chaudhry, Young, and Afshari, 2022; Naik and Suresh, 2019).

KMO and Bartlett's Test

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.89
Bartlett's Test of Sphericity	Approx. Chi-Square	5646.69
	Degree of Freedom	780
	Sig	0.001

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and the Bartlett Test of Sphericity has revealed the statistic suitability of using Exploratory Factor Analysis (EFA) in analyzing the multidimensional logistics

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problem of agri-business retailers in Davao City. The outcome of the KMO offered on table 6 test has the result of 0.890, which depicts a meritorious sampling adequacy (Hair et al., 2019), implying that the interrelationships between the measured variables are strong and close-knit enough to indicate plausible factor structures underlining them. This finding recommends that the challenges associated with infrastructure standards, coordination of last-mile logistics, institutional enabling, and sustainability practices are empirically related issues and not disjointed.

The large KMO value is also in line with the previous agri-business and logistical studies that highlight the systemic feature of logistics constraints in agri-food retail settings. Research by Amin-Chaudhry, Young, and Afshari (2022) and Naik and Suresh (2019) notes that sustainability issues of agri-business like waste reduction, cost pressure, and operational resilience are inherent within logistics and infrastructural systems. On the same note, the research by Dobrodomova et al. (2020) and Md. Aktar Hussain and Guha (2023) highlights the fact that the adequacy of infrastructure is a background determinant of operational stability and economic security to small agricultural enterprises particularly those prone to dislocation and resource shortages.

The Test of Sphericity by Bartlett also supports the appropriateness of the used data to factor analysis, the result of which is highly significant, Ch-square = 5646.689, df = 780, and the value of p is less than 0.001. The null hypothesis is rejected which states that the correlation matrix is an identity matrix indicating that there are significant relationships between the variables. Additionally, this suggests that the items of the survey have common dimensions of agri-business retailer logistics performance, infrastructure resilience, and sustainability behavior. This connectedness is similar to the findings in the last-mile logistics literature, where the conditions of the infrastructure, coordination, and sustainability practices have been demonstrated to have a complementary effect on the performance of logistics (Olsson, Hellström, and Pålsson, 2019; Lagin et al., 2022). The strong KMO value and the statistically significant Bartletts Test together verified that the data is factorable and is methodologically appropriate when it comes to EFA.

Table 4. Total Variance Report

Factor	Eigenvalue	% of Variance Explained	Cumulative Variance
Factor 1	10.478	26.194	26.194
Factor 2	4.896	12.239	38.433
Factor 3	2.42	6.05	44.483
Factor 4	1.643	4.107	48.59

Table 4 gives the Total Variance Report of the exploratory factor analysis where it is indicated that the 4 factors retained in the factor analysis presence a total variance in the variables observed of 48.50 which is attributed to the factors together. This amount of explained variance is deemed as reasonable and methodologically

justifiable when it comes to the nature of exploratory studies requiring multidimensional and complex phenomena to be determined in agri-business logistics and sustainability. The findings indicate that agri-business retailers in Davao City have logistic problems, which are motivated by a small number of strong but connected underlying dimensions as opposed to operational problems in isolation.

Factor 1 (10.478) has the highest proportion of variance (26.19) and is the most dominant factor in determining the result of the last-mile logistics. This aspect indicates fundamental operation and coordination processes that support logistics performance, which align with the literature suggesting that the main role in last-mile logistics systems belongs to coordination, information flows, and operational integration (Olsson, Hellström, and Pålsson, 2019; Lagin et al., 2022). The studies on the topic of digitalization and collaborative logistics offer additional evidence to the significance of this aspect specifically to small and medium agri-businesses with limited resources to operate under (Kuteyi and Winkler, 2022; Giuffrida et al., 2022).

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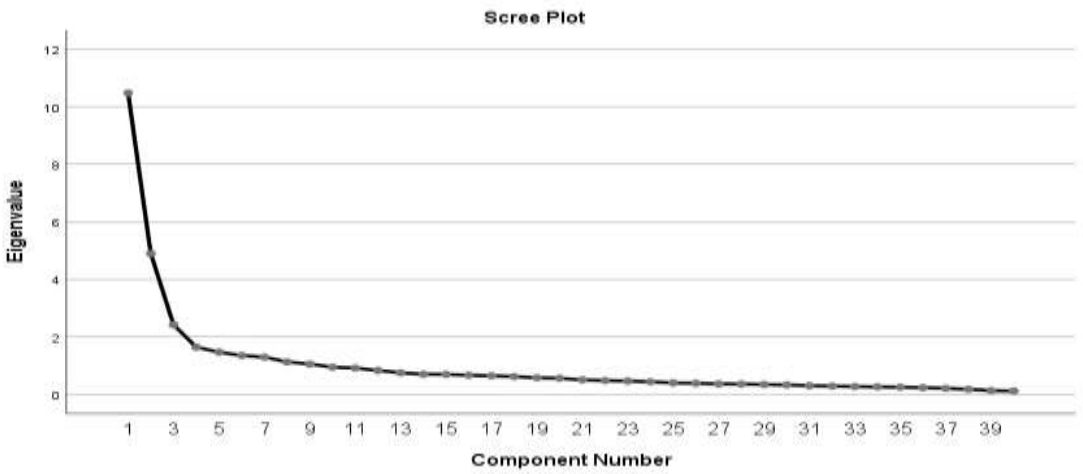
Factor 2 explains an extra 12.24 percent of the variance, bringing the total cumulative explained variance to 38.43. The consideration of this factor captures the impact of institutional and policy-related environments such as governmental support, the regulatory frameworks and initiatives aimed at the public infrastructural development. The importance of the factor is consistent with the available empirical data in the Philippines and other rising economies, where the public-sector intervention and policy coherence are key drivers of agricultural productivity and efficiency of logistical operations in the retail sector (Briones, 2021; Hermoso et al., 2021). The same is observed by Dobrodomova et al. (2020), Md. Aktar Hussain and Guha (2023) who note that the investments in infrastructure and institutional assistance lead to an increase in resilience and economic security in small agri-business systems.

Factor 3 and 4 are responsible of explaining 6.05 percent and 4.11 percent of the variance respectively, making the total cumulative variance to be 48.50. The proportion of these factors is less than that of others, but they should be considered tremendously important dimensions in terms of environmental sustainability practices and transport infrastructure resilience. The consideration of these aspects is theoretically rightful, since sustainability and reliability of infrastructure becomes an essential part of successful agri-food logistics. The existing literature highlights that the mitigation of waste, spoilage, and green operations can be considered key factors that are closely interconnected with logistics performance and long-term competitiveness in agri-retail supply chains (Amin-Chaudhry et al., 2022; Naik and Suresh, 2019; Testa et al., 2022). Similarly, the use of transport infrastructure quality and disruption management capabilities continues to be at the core of the reliable delivery of products, especially perishable goods and services as evidenced in research on last-mile logistics (Fried & Goodchild, 2023; Nguyen et al., 2025). The four-factor solution represents a parsimonious and conceptually sensible solution, representing the most salient dimensions of logistics problems that agri-business retailers experience in Davao City.

Figure 1 Scree Plot



The visual confirmation of the number of factors that should be retained to describe the logistics challenges agri-business retailers in Davao City is found in the scree plot presented in figure 1. As illustrated in the figure, there is a steep drop in eigenvalues between Component 1 and Component 4, then there is an evident leveloff or “elbow" on further components as the fourth component, which indicates that further components can only provide a slight increment in the explanatory power. The pattern indicates the retention of four factors, which agrees with the scree test criterion that is usually suggested in the exploratory factor analysis. It is methodologically consistent with the available recommendations that meaningful latent constructs are already captured before the point at which the curve becomes flat and eigenvalues start to reflect random error instead of substantive dimensions (Rahi, 2017; Creswell and Poth, 2018). Substantively, the prevalence of the former four elements indicates the interrelatedness of infrastructure conditions, last-mile logistics coordination, institutional support, and the sustainability practice as the major drivers of agri-retail logistics performance, which has been extensively known in the literature (Olsson, Hellström, and Pålsson, 2019; Lagin et al., 2022).

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The literature on agri-business and last-mile systems also highlights that though there is a lot of variability in the outcomes of logistics, it can be explained by a small number of structural factors like transport infrastructure, coordination mechanisms, and sustainability constraints (Briones, 2021; Dobrodomova et al., 2020; Amin-Chaudhry, Young, and Afshari, 2022). Therefore, the scree plot has lent credibility to the statistical and theoretical soundness of the fourfactor solution to be used in the analysis of the root causes of last-mile logistics issues in agri-business retailers in Davao City, which justifies its relevance to the study.

Factor loadings are an important output of Exploratory Factor Analysis (EFA) since they measure the degree of strength and direction of the relationship that exists between the observed variables and their latent constructs. The factor loading gives the strength of contribution of an item to a certain factor where the larger the absolute value, the greater is the explanatory relevance. Hair et al. (2019) assert that loadings on factors are critical in determining construct validity and item retention as well as warranting the interpretability of factor solutions, especially in multivariate studies with more complicated behavioral and operational phenomena. In general, Hair et al. (2019) suggest experimental loading of 0.40 to choose exploratory research, and higher cutoffs (e.g., 0.50 or more) are desirable based on the sufficient size of samples to increase measurement accuracy and limit cross-loading problems. When problematic factors loadings are carefully considered in research of infrastructure, last-mile logistics and sustainability, researchers are able to determine which operational, institutional, and environmental indicators exert the greatest impact, making empirical patterns significant to theoretically meaningful and policy-relevant constructs.

Table 5 shows the rotated factor loading of the four factors to be retained following the Exploratory Factor Analysis with Principal Component Analysis with Varimax rotation, which came to a convergence after 11 iterations. Each of the retained items has a high value of factor loading (> 0.50), which matches the suggested practical and statistical significance in exploratory research studies (Hair et al., 2019). It means that the measurement items are strong predictors of the latent constructs they are intended to measure and the factor structure is interpretable and theoretically meaningful.

Table 5. Factor Loading

Item No.	Measurement Item	Factor 1	Factor 2	Factor 3	Factor 4
8	Coordinate orders via phone/text	0.835			
9	Use social media for orders & communication	0.822			
16	Collaboration for shared purchases/deliveries	0.695			
35	Openness to digital logistics tools	0.611			
37	Frequent communication w/ suppliers	0.812			
38	Centralized logistics hubs serve the area	0.638			
39	Collaboration improves supply reliability	0.591			
40	Logistics processes resilient to disruptions	0.51			
5	LGU policies support expansion		0.864		
6	Government grants/training/ programs		0.873		
7	Favorable logistics regulations		0.548		
21	Proper waste segregation			0.75	
22	Immediate separation of spoiled goods			0.707	
23	Minimize environmental impacts			0.785	
24	Price reduction to avoid spoilage			0.649	
18	Delivery despite heavy rain/ flooding				0.658
19	Traffic rarely disrupts deliveries				0.687

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. One rotation converged in 11 iterations.

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Factor 1 has high loadings of communication, coordination, collaboration, and digital interaction items which include phone/text coordination, using social media, communicating with suppliers, and collaborating with other businesses. This finding is consistent with the current literature on the rising role of information flow, collaboration, and digital tools in enhancing the efficiency of last-mile logistics, especially when small agri-businesses are involved in the context of resource limitations (Olsson, Hellström, and Pålsson, 2019; Kuteyi and Winkler, 2022; Giuffrida et al., 2022). The fact that the concept of logistics resilience has been included in this aspect also contributes to the results that collaborative and digital-enabled practices increase the capacity of firms to adapt to everyday disruptions (Lagin et al., 2022; Fried and Goodchild, 2023).

Factor 2, is highly determined by the local government policy items, grants and training programs and conducive regulatory environment. The large loadings of these items indicate the conditionality of the agri-business logistics performance in terms of the influence of the interventions in the public sector. This aligns with the literature which has emphasized the fact that infrastructure investment, policy consistency, and institutional support have a significant effect on the result of agricultural productivity and retail logistics in emerging economies, including the Philippines (Briones, 2021; Hermoso et al., 2021; Dobrodomova et al., 2020).

Factor 3 has high loading in waste segregation, waste spoilage, reduction of impact on the environment and adjustment of prices to reduce food waste. These findings are aligned with the literature on sustainability that highlights that the sustainable management of agri-food supply chains, especially in the context of perishable products, involves effective waste management and practices that facilitate environmental friendliness and sustainability (Amin-Chaudhry, Young, and Afshari, 2022; Naik and Suresh, 2019; Testa et al., 2022). The transparency of loadings on this basis implies that sustainability practices constitute a separate and consistent area of logistics issues in agri-business retailers.

Factor 4 is determined by questions referring to the continuity of the delivery in case of bad weather and low disruption caused by traffic. This aspect reveals the significance of infrastructure stability and resilience in last-mile logistics, which is supported by the previous studies, which indicate transport conditions and exposure to disruptions as crucial determinants of logistics performance to perishable goods (Lagin et al., 2022; Md. Aktar Hussain and Guha, 2023; Fried and Goodchild, 2023).

The factor loadings are clear and well-defined four-factor structure which proves the construct validity of the measurement model. In line with the methodological recommendations (Hair et al., 2019; Rahi, 2017), the high and clear loadings give the assurance that the extracted factors are effective in capturing the underlying dimensions of infrastructure, last-mile logistics, institutional support, and sustainability problems that agri-business retailers in Davao City encounter.

The four factors found during the analysis were labeled using factor interpretation and labeling principles suggested by Hair et al. (2019), to which factor names are to be provided based on the shared conceptual meaning of the items with the highest factor loading instead of being based on statistical characteristics. This was studied after extraction of the factors and Varimax rotation to single out high primary loading (>=0.50) items with low cross-loadings to determine the shared themes in their wordings and concepts. These items were then synthesised and categorised into concise theoretically meaningful labels that define the nature of each factor based on key words and terms that are dominant. Following Hair et al. (2019), the content validity, parsimony, and alignment with extant literature in the field of logistics and sustainability were central to the naming process, making sure that each aspect of the naming factor is a coherent and interpretable latent construct of infrastructure, last mile logistics, and sustainability issues of agri-business retailers.

Factor 1 is labeled as Collaborative Digital Logistics Capability as it represents the most powerful dimension affecting any logistics performance in agri-business retailers in Davao City. This aspect is heavily characterized by high loadings on the items of communication, digital interaction, collaboration, and operational resilience with the factor loads ranging between 0.510 and 0.835, which is over the suggested threshold of practical significance (Hair et al., 2019). The highest loadings are seen to be coordination via phone or text messages (0.835), a regular communication with suppliers (0.812), and the involvement of social media platforms in

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managing orders (0.822), which makes the face of informal but technology-based communication channels central to the maintenance of the last-mile logistics between small agri-retailers.

The prevalence of this aspect coincides with the previous studies that highlight that the successful implementation of the last-mile logistics in agri-food systems becomes more reliant on the collaborative relationships and low-cost digital solutions, in particular, in the resource-constrained environment (Olsson, Hellström, and

Pålsson, 2019; Lagin et al., 2022). Research by Kuteyi and Winkler (2022) and Giuffrida et al. (2022) also adds that digitally enabled communication systems and mutual logistics systems improve the efficiency of coordination and uncertainty in delivery times, which is essential in the case of perishable products. The inclusion of the points concerning the centralized logistical sites and cooperation with other enterprises indicates that agri-retailers do not depend on the separate digital activities but rather on the communal logistical infrastructure to enhance the reliability of supply. In addition, the fact that logistics resilience is loaded to routine shocks is consistent with Fried and Goodchild (2023) who observed that collaborative and digitally enabled logistics resilience is in better positions to absorb daily shocks in the form of traffic jams, supplier delays, and smaller shocks in the infrastructure.

Factor 2 is named Institutional and Policy Support as it measures the influence of the public and regulatory environment to the logistics performance among agri-business retailers in Davao City. This criterion is characterized by high loadings of the items that are associated with local government policies (0.864), the grants, training, and programs provided by the government (0.873), and the favorable regulatory environment concerning logistics (0.548), which is above the threshold of items required in the case of exploratory research (Hair et al., 2019). The large loadings present institutional interventions and policy structures as a particular and powerful aspect of the agri-retailer logistics difficulties.

The relevance of this component is in line with the literature, which underscores the importance of the government and institutional support in enhancing the agribusiness logistic systems, especially in the emergent city economies. to studies conducted by Briones (2021) and Hermoso et al. (2021), infrastructure investment, coherent policies, and specific support programs play a significant role in determining the capacity of small agri-businesses to increase operations and logistics, as well as to manage market and infrastructure limitations. Equally, Dobrodomova et al. (2020) and Md. Aktar Hussain and Guha (2023) note that positive institutional frameworks contribute to economic safety and stability of farming enterprises through providing access to infrastructures, training, and formal logistics systems.

Factor 3 is called Environmental Sustainability and Waste Control as it documents the level of agri-business retailers in which they incorporate environmentally friendly practices in their day-to-day logistics and operations. This aspect is highly determined by the factors concerned with the correct segregation and disposal of waste (0.750), instant separation of spoilages (0.707), minimization of environmental costs, including emission and waste (0.785), and price reduction of near spoilage products to reduce food waste (0.640). Each of the items meets the minimum loading requirement required to conduct exploratory research, which implies a consistent and clear sustainability-focused construct (Hair et al., 2019).

This factor appeared in line with the literature on agri-food and sustainability, which places the management of waste and the minimization of spoilage as the major goals of the perishable supply chains. Amin-Chaudhry, Young, and Afshari (2022) and Naik and Suresh (2019) emphasize that small agri-retailers tend to experience high sustainability motivation but are limited in efficiency in having logistics, which increases the waste and environmental effects. No waste segregation and spoilage control as indicated in this factor are, therefore, not only environmental but also economic strategies to ensure that the margins are not lost and that the product quality is not compromised. Moreover, Testa et al. (2022) state that sustainability-focused activities within the agri-food system are becoming progressively associated with the operational innovation and long-term competitiveness.

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Factor 4 is named Transport Infrastructure and Disruption Resilience as it measures the capacity of the agri-business retailers to maintain logistics operations despite infrastructure limitation and daily disruption. Such factor is characterized by high loading levels of the items connected to continuity of delivery under heavy rain or flood conditions (0.658), low degree of inconvenience caused by traffic conditions (0.687) and gains made to logistics by road and transport projects undertaken by the local government (0.600). The quality and ability of infrastructure to handle exploratory studies are at a level that satisfies the acceptable loading threshold, which means that the nature of infrastructure quality and resilience is a specific and significant dimension of the logistics issues (Hair et al., 2019). The literature on last-mile logistics and agri-food supply chains clearly supports the emergence of this factor and observably designates transport infrastructure and vulnerability to disruptions as key factors of delivery reliability, especially when it comes to perishable goods. Lagin et al. (2022) and Olsson, Hellström, and Pålsson (2019) also specify that the efficiency of last miles and the quality of products are directly influenced by traffic congestion, weather-related disruptions, and road quality. These issues are particularly compounded in the context of developing and emerging economies, as both Briones (2021) and Hermoso et al. (2021) note in the Philippine scenario, with the findings of which illustrate that the unequal development of the infrastructure still limits the performance of agricultural and retail logistics in the country.

Furthermore, the role of government-led road and transport development in this aspect can be complemented by the fact that this factor involves the involvement of state infrastructure development in improving the logistics resilience. Both Dobrodomova et al. (2020) and Md. Aktar Hussain and Guha (2023) establish that the ability of small agri-businesses to endure environmental and operational shocks and enhance economic security and supply persistence is boosted by infrastructure improvement. Regarding the sustainability aspect, Fried and Goodchild (2023) observe that efficient transport systems would ensure that inefficiencies, delays, and unwarranted emissions through fragmented and disrupted last-mile deliveries are minimized. Factor 4 therefore brings out the fact that effective, sustainable and reliable agri-business logistics in Davao City relies on transport infrastructure and disruption resilience as the enablers.

Agri-Business Retailers Logistics Challenges Framework

The proposed framework is a synthesis of the findings of the exploratory factor analysis in that it demonstrates the relationship between four interrelated dimensions that play a cumulative role in determining the logistics challenges of agri-business retailers in Davao City. The central concept of the framework is that the performance of last-mile logistics is not determined by a specific constraint, however, the interaction of collaborative digital capabilities, institutional support, sustainability practices, and transport infrastructure resilience. This cohesive perspective aligns well with the literature on last-mile logistics which highlights the systemic and multi-actorial character of agri-food supply chain logistics problems (Olsson, Hellström, and Pålsson, 2019; Lagin et al., 2022).

Figure 2 Agri-Business Retailers Logistics Challenges Framework

The first element, Collaborative Digital Logistics Capability, puts emphasis on the value of communication, the digital tools, and the collaboration of firms in order to synchronize orders, handle the deliveries and address the

daily disruptions. Previous research indicates that inexpensive digital services and collaborative design contribute greatly to the resilience of small agribusinesses and their effectiveness of organization and coordination, especially in less-developed countries where there is a lack of formal logistics infrastructure (Kuteyi and Winkler, 2022; Giuffrida et al., 2022). This aspect indicates the role of digital and relational capabilities as very important enablers of successful last-mile logistics.

The second element, Institutional and Policy Support, highlights the importance of local government policies, regulatory environments and government programs in the formation of logistics outcomes. Investigations always show that effective institutional systems and investments in infrastructure enhance efficiency in logistics, business growth, and resilience within the farming industry (Briones, 2021; Hermoso et al., 2021; Dobrodomova et al., 2020). This factor is the enabling environment in the framework that preconditions the effectiveness of agri-retailers operating in the last mile.

The third component is Environmental Sustainability and Waste Control, which encompasses the element of sustainability in the logistics performance. Agri-food systems Literature highlights that waste management, spoilage, and environmentally responsible practices cannot be discussed outside of the context of logistics efficiency, particularly when it comes to perishable products (Amin-Chaudhry, Young, and Afshari, 2022; Naik and Suresh, 2019; Testa et al., 2022). This aspect indicates the increased awareness of the fact that sustainability does not represent only an ethical issue but also a structural factor that defines the feasibility of operations in agri-retail logistics.

Lastly, Transport Infrastructure and Disruption Resilience are used to reflect the role of road quality, traffic, weather-related disruption and investment in public transport in determining the reliability of delivery. Research on both the idea of lastmile logistics and the concept of regional development repeatedly claims that infrastructure resilience is one of the fundamental factors that enable the support of supply continuity and minimization of inefficiencies in agri-food distribution (Fried and Goodchild, 2023; Md. Aktar Hussain and Guha, 2023; Lagin et al., 2022). In the framework, this aspect connects the physical aspect of logistics that is in contact with digital, institutional, and sustainability.

This model is supported by literature that advocates a comprehensive and combined perspective on how to understand the last-mile logistics issues within an agri-business (Nguyen et al., 2025; Olsson et al., 2019). The framework offers a strong analytical perspective of explaining the realities of logistics of agri-business retail in Davao City due to the positioning of the four factors as convergent drivers of logistics and offers a practical basis of policy interventions, managerial strategies and confirmatory research in future.

CONCLUSION

The researchers conclude that the Agri-business retail logistics challenges are multidimensional in nature. The study confirms that logistics challenges faced by agribusiness retailers in Davao City cannot be explained by a single constraint but instead arise from the interaction of digital capabilities, institutional support, sustainability practices, and transport infrastructure conditions. Thus, there is a need for integrated approaches when addressing last-mile logistics issues in Agri-retailing.

The study also concludes that Collaborative Digital Logistics Capability is the most critical driver of last-mile performance. The prominence of this factor indicates that communication, collaboration, and the use of affordable digital tools are essential for coordinating deliveries, managing supplier relationships, and responding to routine disruptions. This highlights how small agri-retailers rely on relational and technology enabled practices to compensate for limited resources.

Moreover, the study likewise concludes that institutional and policy support plays a structural role in enabling retail logistics efficiency. Local government policies, regulatory frameworks, and support programs significantly influence retailers' ability to expand, improve logistics operations, and maintain business continuity. This underscores the importance of coherent governance and sustained public-sector investment in strengthening agri-retail logistics systems.

In terms of environmental sustainability and waste control, the researchers conclude that these are integral to agri-retail logistics and not secondary concerns. The findings show that waste segregation, spoilage reduction, and environmentally responsible practices form a distinct logistics dimension, particularly for perishable products. Sustainability practices are closely linked to cost control, product quality, and long-term operational viability.

Moreover, the study likewise concludes that transport infrastructure and disruption resilience remain foundational to last-mile reliability. Road quality, traffic conditions, weather-related disruptions, and public infrastructure projects significantly affect delivery consistency. Even with strong digital and collaborative capabilities, weak infrastructure can undermine logistics performance, highlighting the continued relevance of physical connectivity in retailing.

Novel findings include that Agribusiness last-mile logistics is a multidimensional system driven by four distinct latent dimensions. Rather than being explained by isolated operational issues, the study demonstrates that agribusiness last-mile logistics in Davao City is shaped by four interrelated dimensions: Collaborative Digital Logistics, Government Support, Environmental Sustainability, and Physical Access and Infrastructure Resilience. This provides an empirically validated framework for understanding last-mile logistics beyond traditional transportation or delivery perspectives.

Another novel finding is that Digital collaboration and institutional support are more influential than physical infrastructure alone. The EFA findings reveal that digital coordination among supply chain stakeholders and supportive government policies emerge as separate and prominent dimensions, indicating that improving last-mile logistics requires more than investments in roads and transport infrastructure. Effective logistics performance also depends on information sharing, inter-organizational collaboration, regulatory support, and sustainability practices, reflecting the growing importance of governance and digital transformation in agribusiness supply chains.

Furthermore, the results of the study likewise affirm the key principles of the theory of retailing. Consistent with the theory, the study demonstrates that agri-retailers function as adaptive intermediaries whose survival depends on their ability to ensure product availability, accessibility, and responsiveness under changing environmental conditions. The identified factors reflect how retailers adjust their logistics practices in response to institutional, technological, and infrastructural pressures.

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