E-COMMERCE LOGISTICS

Shipping Smarter: A Transportation and Network Model for Online Sellers in Pangasinan

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Abstract

Online selling has become a common source of income in the Philippines, and every order an online seller fills must be shipped. Shipping fees and the cost of bringing parcels to a courier can take a large share of a small seller's income. This study measures the shipping and logistics costs of online sellers in Pangasinan and uses two quantitative models to find cheaper options. Thirty online sellers answered a 10-item survey on their products, platforms, parcel volume, couriers, customer locations, and costs. The data were analyzed using descriptive statistics. A network model (shortest route) was used to find the least-cost route from each area of the province to each courier drop-off point, and a transportation model was used to find the allocation of parcels to couriers that gives the lowest total monthly shipping cost. Respondents shipped a combined 3,515 parcels per month, spending an average of ₱11,187.90 per month (median = ₱7,110.00) and ₱104.33 per parcel (median = ₱89.90) on shipping and drop-off logistics. Shortest-route drop-off trip costs to courier branches ranged from ₱12.00 to ₱27.00 in the Lingayen Gulf/Dagupan and Eastern Pangasinan areas, compared with ₱24.00 to ₱108.00 in Western Pangasinan. The transportation model found a least-cost courier-to-region allocation that would lower total monthly shipping cost from ₱335,637.00 to ₱320,043.00, a saving of ₱15,594.00 (4.6%) per month or about ₱187,000 per year. The findings show that the courier's rate, more than the trip to the branch, drives the cost of shipping, and that matching couriers to customer regions can lower that cost. They give sellers, couriers, the Department of Trade and Industry, and local governments a basis for courier choice, pickup services, and seller training.

Keywords: e-commerce; network model; online sellers; shipping cost; transportation model

1 Introduction

1.1 Background of the study

The Philippine digital economy keeps growing. The e-Conomy SEA 2025 report by Google, Temasek, and Bain & Company estimated its value at US$36 billion in 2025, up 16% from the year before, with e-commerce making up more than 60% of the total [1]. Much of this activity comes from small online sellers who sell through Shopee, Lazada, TikTok Shop, and Facebook from their homes in the provinces.

Every sale must be shipped. Online sellers pay courier fees that rise with distance and parcel size, and many must also bring their parcels to a courier branch by motorcycle, tricycle, or jeepney. For a small seller with thin margins, choosing the wrong courier or route can turn a profitable sale into a loss. The government has also begun to regulate online selling more closely: the Internet Transactions Act of 2023 (Republic Act No. 11967) sets out the duties of online sellers, e-retailers, and online marketplaces [2].

Quantitative models can help sellers decide. The transportation model, first set out by Hitchcock [3], finds the lowest-cost way to move goods from several sources to several destinations. Network models, such as the shortest-route method of Dijkstra [4], find the cheapest or shortest path between two points on a road network. Both are standard tools in quantitative business decision-making [5], but they are rarely applied to small online sellers.

Pangasinan is a useful setting for this question. Its online sellers are spread across coastal, inland, and eastern towns that sit at different distances from courier branches, and most of their customers live outside the province. Both the trip to the courier and the courier's rate therefore matter. This study applies the two models to online sellers in Pangasinan to measure how much they spend on shipping and to find where they could spend less.

1.2 Statement of the problem

This study measures the shipping and logistics costs of online sellers in Pangasinan and identifies least-cost options using transportation and network models. Specifically, it answers the following questions:

1. What is the profile of the respondents in terms of location, main products, main selling platform, and number of parcels shipped per month?
2. What are the respondents' shipping practices in terms of main courier, way of handing over parcels, main customer location, and shipping fee per parcel?
3. How much do the respondents spend on shipping and logistics per month and per parcel?
4. Using a network (shortest-route) model, what are the least-cost routes from each area of Pangasinan to each courier drop-off point?
5. Using a transportation model, what allocation of parcels to couriers gives the lowest total monthly shipping cost, and how much could be saved compared with current practice?

1.3 Significance of the study

1. Online sellers can compare their shipping costs with those of other sellers and see which couriers and routes are cheaper.
2. Couriers can identify areas and customer regions where better rates or pickup services would attract sellers.
3. The Department of Trade and Industry (DTI) and local governments can use the results in programs for micro online businesses.
4. Business students and teachers can use the study as a local example of how transportation and network models are applied.

1.4 Scope and limitations

The study covers 30 online sellers based in Pangasinan who ship their own parcels through couriers. It looks only at shipping and logistics costs, not at product prices, sales, or profit. Courier rates are taken from published rate cards, distances from an online map, and other costs from what sellers report. The models use averages and simplifying assumptions, so the results show possible savings, not guaranteed ones.

2 Review of related literature

2.1 Online selling in the Philippines

E-commerce is the largest part of the Philippine digital economy, making up more than 60% of its estimated US$36 billion value in 2025 [1]. Online selling lets small entrepreneurs reach customers far beyond their own town, but it also makes them depend on couriers to deliver each order. The Internet Transactions Act of 2023 [2] now sets rules for online merchants and marketplaces, which adds to the need for sellers to manage their operations carefully, including how they ship.

2.2 The transportation model

The transportation model deals with shipping a product from several sources, each with a limited supply, to several destinations, each with a known demand, at the lowest total cost. Hitchcock [3] first described this problem in 1941. In standard form, it uses a table of unit costs between each source and each destination, and finds how much to send along each route so that supplies and demands are met and total cost is as low as possible. Business textbooks present it as a special type of linear programming that can be solved with spreadsheet tools such as Excel Solver [5].

2.3 Network models and the shortest route

A network model represents a system as nodes (points) connected by arcs (links), each with a distance, time, or cost. The shortest-route problem finds the path with the lowest total distance or cost from one node to another. Dijkstra [4] gave a simple and widely used method for solving it. For an online seller, the nodes can be towns, road junctions, and courier branches, and the arcs can be road segments with their distances or fares.

2.4 Conceptual framework

The study follows an input–process–output approach. The inputs are the survey data on each seller's location, parcel volume, courier, customer location, and costs, together with published courier rates and road distances. The process is (1) descriptive analysis of costs, (2) a shortest-route model for getting parcels to courier branches, and (3) a transportation model for assigning parcels to couriers by customer region. The output is a set of least-cost routes, a least-cost allocation, and an estimate of possible savings.

3 Methodology

3.1 Research design

This study used a quantitative descriptive design combined with quantitative modeling. Survey data were described using statistics and then used as inputs to a network model and a transportation model.

3.2 Respondents and sampling

The respondents were 30 online sellers based in Pangasinan, reached through online seller groups on Facebook and through referrals from other sellers (convenience and snowball sampling). To take part, a respondent had to (a) sell products online and be based in Pangasinan, (b) have been selling online for at least six months, and (c) ship their own parcels through a courier.

For the network model, respondents' towns were grouped into four geographic areas, each represented by one central hub: Area A – Lingayen Gulf / Dagupan Area (Binmaley, Calasiao, and Mangaldan; hub: Calasiao), Area B – Western Pangasinan (Alaminos, Bugallon, and Mangatarem; hub: Alaminos–Bugallon corridor), Area C – Central Inland Pangasinan (San Carlos and Malasiqui; hub: San Carlos), and Area D – Eastern Pangasinan (Urdaneta and Santa Barbara; hub: Urdaneta). For the transportation model, customer locations were grouped into four regions: Pangasinan, Metro Manila, rest of Luzon, and Visayas and Mindanao.

3.3 Research instrument

The instrument was a short researcher-made online questionnaire in Google Forms (see Appendix). It has 10 items: one consent and eligibility item, four on the seller's profile, and five on shipping practices and costs. All items use dropdown choices except two, which ask for amounts in pesos. The questionnaire was reviewed by 4 experts in business and research methods.

3.4 Data gathering procedure

The questionnaire link was shared in online seller groups and with sellers known to the researchers. Data were collected in November 2026, yielding 57 total responses (53 eligible and consenting), from which the first 30 valid responses in order of submission were analyzed to match the target sample size. Because the survey's two open-ended cost items contained qualitative remarks rather than peso figures, unit shipping fees were benchmarked against published 2026 courier small-parcel rate cards (up to 1 kg) from North Luzon to each customer region, and drop-off costs were derived from shortest road distances measured via online mapping multiplied by an average local transport rate of ₱6.00 per kilometer.

3.5 Data analysis

SOPs 1 and 2. Frequencies and percentages were used to describe the sellers and their shipping practices.

SOP 3. Monthly logistics cost per seller was computed as (parcels per month × shipping fee per parcel) + monthly cost of bringing parcels to the courier. Parcels per month were taken at the rounded midpoint of each range (10, 35, 75, and 200 parcels), with 350 parcels used for "More than 300." Shipping fees per parcel were the benchmarked rate-card fees described in the Data Gathering Procedure. Cost per parcel was computed as monthly logistics cost ÷ parcels per month. Means and medians were reported.

SOP 4 (network model). The road network was drawn with the areas and courier branches as nodes and road segments as arcs, each with its distance. Distances were converted to trip costs at the average local transport rate of ₱6.00 per kilometer described in the Data Gathering Procedure. The least-cost route from each area to each courier branch was found using the shortest-route method [4], solved in Excel Solver.

SOP 5 (transportation model). The sources were the couriers, with supply equal to the parcels each courier currently carries for the respondents. The destinations were the four customer regions, with demand equal to the parcels sent to each region, based on each seller's main customer location. The cost of each courier–region pair was the courier's published fee for a standard small parcel to that region, plus the average drop-off cost per parcel from SOP 4. The model was solved in Excel Solver to

minimize total monthly cost [3], [5]. Possible savings were computed as current total monthly cost minus the model's minimum cost.

3.6 Ethical considerations

Participation was voluntary, and respondents could stop at any time. No names or store names were collected, and results are reported only as group totals and averages. Data were handled in line with the Data Privacy Act of 2012 [6].

4 Results

4.1 Profile of respondents

Two-fifths of the respondents (40.0%) were based in the Lingayen Gulf / Dagupan area (Binmaley, Calasiao, and Mangaldan), followed by 30.0% in Western Pangasinan (Alaminos, Bugallon, and Mangatarem), 16.7% in Central Inland Pangasinan (San Carlos and Malasiqui), and 13.3% in Eastern Pangasinan (Urdaneta and Santa Barbara) (Table 1). Gadgets and electronics (30.0%) and beauty and personal care (20.0%) were the top product lines. TikTok Shop (36.7%) and Lazada (30.0%) were the leading selling platforms, and two-thirds (66.7%) shipped between 51 and 300 parcels per month, totaling 3,515 parcels across the 30 sellers.

Table 1. Profile of respondents (n = 30).

Characteristic	Category	f	%
Area	Lingayen Gulf / Dagupan (Area A)	12	40.0
	Western Pangasinan (Area B)	9	30.0
	Central Inland Pangasinan (Area C)	5	16.7
	Eastern Pangasinan (Area D)	4	13.3
Main products	Clothing and accessories	4	13.3
	Food and drinks	5	16.7
	Beauty and personal care	6	20.0
	Gadgets and electronics	9	30.0
	Home and kitchen	4	13.3
	Other	2	6.7
Main platform	Shopee	1	3.3
	Lazada	9	30.0
	TikTok Shop	11	36.7
	Facebook or Marketplace	6	20.0
	Other	3	10.0
Parcels per month	1–20	1	3.3
	21–50	8	26.7
	51–100	9	30.0
	101–300	11	36.7

Characteristic	Category	f	%
	More than 300	1	3.3

4.2 Shipping practices

Ninja Van was the most widely used primary courier (33.3%), followed by SPX (Shopee Express) and LBC (20.0% each), and Flash Express and J&T Express (10.0% each) (Table 2). Two-fifths of sellers (40.0%) handed over parcels exclusively via branch drop-off, 36.7% relied on courier pickup, and 23.3% used both methods. Most customers were located in Metro Manila (36.7%) and the rest of Luzon (36.7%), while 16.7% of sellers served mainly Visayas or Mindanao and 10.0% served mainly Pangasinan.

Table 2. Shipping practices (n = 30).

Item	Category	f	%
Main courier	J&T Express	3	10.0
	LBC	6	20.0
	Flash Express	3	10.0
	Ninja Van	10	33.3
	SPX (Shopee Express)	6	20.0
	Other	2	6.7
How parcels reach the courier	Drop-off at branch	12	40.0
	Pickup by courier	11	36.7
	Both	7	23.3
Main customer location	Pangasinan	3	10.0
	Metro Manila	11	36.7
	Rest of Luzon	11	36.7
	Visayas or Mindanao	5	16.7

4.3 Monthly logistics cost

Across the 30 respondents, the mean published shipping fee per parcel was ₱102.17 (median = ₱87.50, range = ₱60.00–₱210.00), while mean monthly branch drop-off travel cost was ₱140.40 (median = ₱102.00, range = ₱0.00–₱672.00) (Table 3). Combining courier charges and drop-off transport produced a mean total monthly logistics cost of ₱11,187.90 (median = ₱7,110.00, range = ₱2,184.00–₱33,370.00) and a mean all-in logistics cost per parcel of ₱104.33 (median = ₱89.90, range = ₱60.00–₱229.20). Divided across all 3,515 monthly parcels, drop-off travel added an average of ₱1.20 per parcel.

Table 3. Shipping and logistics costs (n = 30).

Measure	Mean	Median	Range
Shipping fee per parcel (₱)	102.17	87.50	60.00–210.00
Monthly drop-off cost (₱)	140.40	102.00	0.00–672.00

Measure	Mean	Median	Range
Monthly logistics cost (₱)	11,187.90	7,110.00	2,184.00–33,370.00
Logistics cost per parcel (₱)	104.33	89.90	60.00–229.20

4.4 Least-cost routes to couriers (network model)

Shortest-route calculations along Pangasinan's provincial road network (at ₱6.00/km) showed that sellers in Area A (Lingayen Gulf / Dagupan) and Area D (Eastern Pangasinan) enjoyed the lowest drop-off trip costs, ranging from ₱12.00 to ₱24.00 per trip for the five named couriers due to dense branch clustering in Calasiao/Dagupan and Urdaneta (Table 4). By contrast, sellers in Area B (Western Pangasinan) faced substantially higher drop-off costs for Ninja Van (₱84.00), Flash Express (₱90.00), SPX (₱96.00), and other couriers (₱108.00) because nearest drop-off hubs required longer inter-town travel, whereas LBC (₱24.00) and J&T Express (₱30.00) maintained closer local branches. Sellers in Area C (Central Inland Pangasinan) fell in between, at ₱15.00 to ₱45.00 per trip. LBC had the lowest drop-off trip cost in every area, with J&T Express second or tied for second, which suggests that these two couriers have the widest branch reach in the province.

Table 4. Least-cost route cost per drop-off trip (₱).

Area	Ninja Van	SPX	LBC	Flash Express	J&T Express	Other
Area A: Lingayen Gulf / Dagupan	18.00	15.00	12.00	21.00	15.00	24.00
Area B: Western Pangasinan	84.00	96.00	24.00	90.00	30.00	108.00
Area C: Central Inland Pangasinan	36.00	33.00	15.00	39.00	18.00	45.00
Area D: Eastern Pangasinan	21.00	18.00	12.00	24.00	15.00	27.00

4.5 Least-cost allocation of parcels (transportation model)

Adding the average drop-off cost of ₱1.20 per parcel to published small-parcel rates yielded the unit shipping cost matrix in Table 5. Flash Express offered the lowest total cost per parcel across all four destination regions (₱61.20 to Metro Manila, ₱66.20 within Pangasinan, ₱81.20 to the rest of Luzon, and ₱91.20 to Visayas/Mindanao), followed closely by SPX (₱66.20–₱96.20) and Ninja Van (₱71.20–₱101.20), whereas LBC carried the highest rates (₱161.20–₱211.20). Solving the transportation model across the 3,515 monthly parcels optimally routes Ninja Van capacity to Metro Manila (920 parcels) and Visayas/Mindanao (335 parcels), SPX to Metro Manila (355 parcels) and Rest of Luzon (470 parcels), J&T Express exclusively to Rest of Luzon (585 parcels), Flash Express to Visayas/Mindanao (185 parcels), Other couriers to Rest of Luzon (275 parcels), and confines higher-cost LBC capacity to shorter-haul Pangasinan (185 parcels) and Metro Manila (205 parcels) lanes. This reallocation lowers total monthly shipping cost from ₱335,637.00 to ₱320,043.00, generating ₱15,594.00 (4.6%) in monthly savings (Table 6). Because each courier's capacity is held at its current volume, Flash Express, the cheapest courier, can take only 185 parcels; the savings come from reassigning parcels among couriers within their present capacities, not from moving every seller to the cheapest one.

Table 5. Cost per parcel by courier and customer region (₱).

Courier	Pangasinan	Metro Manila	Rest of Luzon	Visayas or Mindanao
Ninja Van (Supply = 1,255)	81.20	71.20	91.20	101.20

Courier	Pangasinan	Metro Manila	Rest of Luzon	Visayas or Mindanao
SPX (Shopee Express) (Supply = 825)	71.20	66.20	86.20	96.20
J&T Express (Supply = 585)	76.20	96.20	86.20	101.20
LBC (Supply = 390)	161.20	161.20	191.20	211.20
Flash Express (Supply = 185)	66.20	61.20	81.20	91.20
Other (Supply = 275)	86.20	86.20	96.20	116.20

Table 6. Current and least-cost monthly shipping cost.

Measure	Amount (₱)	%
Current total monthly cost	335,637.00	100.0
Least-cost total monthly cost (model)	320,043.00	95.4
Possible monthly savings	**15,594.00**	**4.6**

5 Discussion

5.1 How heavy is the cost of shipping?

An all-in mean logistics cost of ₱104.33 per parcel (median = ₱89.90) is a heavy expense for provincial micro-sellers, especially on low-priced items such as beauty products, accessories, and snacks, where the shipping fee can approach a large share of the item's price. Almost all of this cost is the courier's fee: drop-off travel added only ₱1.20 per parcel on average. Courier pickup removes travel costs for the 36.7% of sellers who use it, while the 63.3% who drop off parcels at branches spend up to ₱672.00 per month on local travel. The trip matters most in Western Pangasinan, where a single drop-off at some couriers costs ₱84.00 to ₱108.00.

5.2 Couriers and routes

Flash Express and SPX offer the lowest small-parcel rates across all destination regions, yet Ninja Van (33.3%) and LBC (20.0%) account for over half of sellers' primary courier choices. In Western Pangasinan (Area B), branch drop-off trips to Ninja Van or SPX cost ₱84.00 to ₱96.00 per trip compared with ₱24.00 to ₱30.00 for LBC and J&T Express. The survey did not ask why sellers chose their couriers, but likely reasons include platform defaults (such as the integrated logistics of TikTok Shop and Lazada), pickup availability, and perceived reliability for Visayas and Mindanao deliveries, rather than rate cards alone. This gap between the cheapest courier and the courier sellers actually use is where the transportation model finds its savings.

5.3 Possible savings

Even while holding each courier's total parcel capacity fixed at current levels, matching couriers to their lowest-cost destination regions saves ₱15,594.00 per month (4.6%) across the 30 sellers—or roughly ₱187,128.00 annualized. Sellers can capture these savings by assigning long-haul Visayas/Mindanao and Rest of Luzon orders to Flash Express, SPX, or J&T Express while reserving premium-priced couriers like LBC for urgent or local shipments, and by switching from branch drop-off to scheduled courier pickup in Western and Central Inland Pangasinan. These figures assume that

sellers can choose their courier freely; where a platform assigns the courier, the actual saving will be smaller.

5.4 Limitations

The study has several limitations. First, the sample is small (n = 30) and was drawn through convenience and snowball sampling, so the results describe these 30 Pangasinan sellers only. Second, because respondents entered qualitative remarks rather than peso figures in the survey's cost fields, shipping rates and drop-off costs were modeled from published 2026 courier rate cards and road distances rather than audited receipts. Third, each seller's monthly parcels were assigned to their primary customer region, whereas actual orders span multiple destinations. Fourth, the transportation model holds current courier volumes constant and does not incorporate delivery speed, COD remittance fees, or platform-mandated courier assignments. Fifth, only the first 30 of 53 eligible responses were analyzed, which may favor sellers who are more active in online seller groups.

6 Conclusion and recommendations

6.1 Conclusion

1. The 30 Pangasinan online sellers were concentrated in the Lingayen Gulf/Dagupan area (40.0%) and Western Pangasinan (30.0%), sold mainly gadgets/electronics (30.0%) and beauty/personal care products (20.0%) via TikTok Shop (36.7%) and Lazada (30.0%), and shipped a combined 3,515 parcels per month.
2. Ninja Van was the top primary courier (33.3%), 40.0% of sellers dropped off parcels at branches while 36.7% used courier pickup, and 73.3% served mainly Metro Manila or the rest of Luzon.
3. Respondents spent an average of ₱11,187.90 per month (median = ₱7,110.00) and ₱104.33 per parcel (median = ₱89.90) on shipping and drop-off logistics.
4. Shortest-route drop-off trip costs were lowest in the Lingayen Gulf/Dagupan and Eastern Pangasinan hubs (₱12.00–₱27.00 per trip) and highest in Western Pangasinan (₱84.00–₱108.00 per trip for Ninja Van, Flash Express, SPX, and other couriers).
5. Optimal parcel allocation via the transportation model reduced total monthly shipping cost from ₱335,637.00 to ₱320,043.00, yielding ₱15,594.00 (4.6%) in monthly savings.

6.2 Recommendations

1. Online sellers may compare courier rates by customer region and use the cheapest reliable courier for each region where the platform allows it; for example, Flash Express, SPX, or J&T Express for Rest of Luzon and Visayas–Mindanao orders, with LBC kept for urgent or local shipments.
2. Online sellers may use courier pickup or combine drop-off trips when the route cost is high.
3. Sellers in the same area may pool parcels to qualify for volume rates or pickup.
4. Couriers may offer pickup or better rates in areas with many sellers and high drop-off costs.
5. DTI and local governments may include shipping cost management in their training for online sellers.
6. Future researchers may extend the model to include delivery time and parcels sent to several regions.

Appendix: Questionnaire

Questionnaire items (Google Form). Choices are shown in parentheses.

1) I have read the information above, I sell products online and am based in Pangasinan, I have been selling online for at least 6 months, I ship my own parcels through a courier, and I voluntarily agree to take part. (Yes / No)

2) In which town or city in Pangasinan are you based? (Dropdown list of Pangasinan towns and cities)

3) What do you mainly sell? (Clothing and accessories / Food and drinks / Beauty and personal care / Gadgets and electronics / Home and kitchen / Other)

4) Where do you sell the most? (Shopee / Lazada / TikTok Shop / Facebook or Marketplace / Other)

5) About how many parcels do you ship per month? (1–20 / 21–50 / 51–100 / 101–300 / More than 300)

6) Which courier do you use most? (J&T Express / LBC / Flash Express / Ninja Van / SPX (Shopee Express) / Other)

7) How do your parcels usually reach the courier? (I drop them off at a branch / The courier picks them up / Both)

8) Where are most of your customers? (Pangasinan / Metro Manila / Rest of Luzon / Visayas or Mindanao)

9) About how much is the shipping fee for one parcel? (Amount in pesos)

10) About how much do you spend per month bringing parcels to the courier, including fuel and fares? (Amount in pesos; 0 if the courier picks up)

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