



Enhancing Organizational Performance in the Agro-Allied Sector: The Role of Route Planning Management in South-South Nigeria

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Abstract

In every economy in the world, but especially in those with abundant agricultural resources, the agro-allied sector is vital. In addition to creating job opportunities and guaranteeing food security, the industry makes a substantial contribution to the nation's GDP. This empirical study examines how to improve organizational performance in the agro-allied business through route planning and management. Although route planning management has been the subject of numerous research, few have looked into the connection between organizational performance and route planning management. The goal of this study is to close the gap. By tackling these goals, this research will help shed light on how shipment evaluation management affects organizational performance in the agro-allied sector. Surveys, interviews, and econometric analysis were all used in this mixed-methods study. The population, which comprises 950 employees from six (6) agro-allied businesses situated in the South-South region of Nigeria, was the sample size of 950 that was used. Demographic variables were evaluated using means and percentages. The data was analyzed using multi-regression analysis and the chi-square distribution at the $P < 0.001$ level of significance to assess the hypothesis's validity. The findings are presented graphically and in tables. The study's findings demonstrate that route planning management greatly improves organizational performance, which in turn boosts the South-South Nigerian economy.

INTRODUCTION

There is currently a major paradigm shift in the way that the global agro-allied industry coordinates the movement of goods. Effective route management has become a crucial and essential factor impacting the operational capabilities of companies in this industry. Product transportation from farmers to markets and processing facilities to distributors is guaranteed by efficient route management. Because of "the need for timely transportation of agricultural products to different parts of the country and beyond," route management has become more and more

crucial in Nigeria, where agriculture is one of the main economic drivers. Furthermore, effective route management contributes to the reduction of post-harvest losses, which frequently arise from transit delays and inadequate storage facilities (Alhassan & Osewe, 2021).

The Nigerian economy depends heavily on the agro-allied sector, which includes a number of industries like agriculture, food processing, and livestock production. Effective route management is essential in this sector to guarantee the seamless movement of commodities and maximize organizational performance. Therefore, the strategic planning, coordinating, and controlling of transportation activities within an organization is referred to as route management. It entails the effective transportation of equipment, raw materials, and agricultural products between locations (Akinyemi, 2019). Numerous aspects, including supply chain management efficacy, operational efficiency, productivity, and financial performance, impact organizational success in the agro-allied sector (Dike & Mughal, 2020). Nonetheless, the accomplishment of strategic goals, targets, and objectives by an organization is a component of organizational performance. According to Abang, Arasomwan, and Ayodele (2024), the exchange rate and the high PMS price are the two factors that determine food price inflation in addition to insecurity. Agro-allied products could be routed to a manageable location with maximum profit, which hinders organizational performance. Additionally, Abang et al. (2024) added that commercial farmers now take their produce to neighboring countries like Ghana, Cameroon, and Niger to sell and earn in their currencies, which, when converted to the Naira, gives them more money.

An essential component of guaranteeing the effectiveness and productivity of operations in the agro-allied sector is the impact that route management has on organizational performance. This is due to the fact that efficient route management can help optimize supply chain operations, which can lead to improved organizational performance. Furthermore, efficient route management can shorten lead times and lower the frequency of production process delays and downtimes, which eventually lowers waste and boosts organizational productivity. Maintaining productivity, cutting transportation expenses, and guaranteeing on-time delivery of goods all depend on efficient route operations management (Kaul & Khurana, 2022).

Therefore, shipment appraisal, route planning, fleet maintenance, warehousing, and freight audit are all necessary for an efficient route operations management. "Proper evaluation reduces the risk of delivering subpar or damaged goods, thereby enhancing productivity, and reducing potential losses" if the amount, quality, and condition of incoming and exiting shipments do not match the necessary requirements. It is rather depressing to observe that businesses, including SMEs, in Nigeria continue to confront a number of obstacles that make it difficult for them to survive on a daily basis. As was already mentioned, the growth of SMEs around the world has a good effect on development, despite a number of significant obstacles that agro-allied businesses must also overcome.

In order to guarantee on-time delivery, reduce expenses, and boost overall effectiveness, route planning management is also essential. Finding the best and most effective routes for the transportation of goods is the main focus of route planning management. This entails considering a number of variables, including delivery schedules, road conditions, traffic flow, and distance. As a result, businesses can reduce transportation costs, expedite delivery times, and enhance supply chain effectiveness in general (Yee & Bicheno, 2018).

Similar to this, the majority of agro-allied businesses' inadequate route planning management led to bad delivery lead times, which resulted in delays and higher transportation costs. Additionally, a lack of real-time tracking and monitoring

systems may lead to more delivery downtime and less reliable deliveries. For agro-allied businesses, these problems lead to delays, unhappy consumers, and diminished customer confidence.

Literature Review

Theories that relate to and clarify the relationship between the operational performance of agro-allied firms and the management of transportation logistics form the basis of this study. In particular, these theories include system theory and queuing theory. Every theory is directly related to the research.

The mathematical study of waiting lines, or queues, is known as queuing theory. It examines the behavior and features of queues, including waiting times, arrival and service rates, queue lengths, and overall system performance. In order to comprehend and maximize the effectiveness of queuing systems, the theory offers quantitative models (Erlang, 1917; Gross & Harris, 2008). Early in the 20th century, Danish engineer Agner Krarup Erlang created the hypothesis. Erlang laid the groundwork for queuing theory with his work on phone call routing. The following are some ways that queuing theory relates to the study of route management and organizational performance:

Route planning management: By taking into account variables like trip time, distance, and traffic levels at various places, queuing theory helps discover the best routes, increasing delivery efficiency overall. **Fleet Maintenance Management:** By taking into account the service time of vehicles and matching it with maintenance schedules, queuing theory helps predict and manage maintenance needs, minimizing downtime and maximizing fleet availability (Bierlaire & Crittin, 2012).

An interdisciplinary framework called system theory looks at how various parts of a system interact and are connected to one another. According to this perspective, systems are intricate structures composed of interdependent pieces, and modifications to one component may have repercussions for the entire system. In the 1940s, Austrian biologist Ludwig von Bertalanffy introduced the idea of system theory. He created the theory to offer a cohesive framework for comprehending a range of phenomena in diverse fields (Senge, 2006).

System theory can be used to analyze and optimize an organization's route system in relation to route management and organizational performance. In order to ensure the efficient movement of goods and materials, route management includes the strategic planning, coordination, and execution of transportation activities. Managers can view the entire route system as a complex entity and determine the interdependencies and feedback loops that impact organizational performance by using a system thinking approach. Organizations can make well-informed decisions to enhance overall performance by knowing how adjustments to one facet of route management may affect other elements, such as inventory levels, productivity, or cost efficiency (Checkland & Poulter, 2006). Route and delivery schedule optimization, for instance, can lower transportation expenses, lower the cost of keeping inventory on hand, and increase efficiency.

System theory is extremely pertinent to the study of organizational performance and route management. System theory provides a framework for understanding and analyzing complex systems by analyzing the relationships between its components and their interactions with "the surroundings." System theory helps understand how different elements, such as transportation networks, cars, drivers, warehouses, and consumers, are interconnected and affect an organization's overall performance when it comes to route management (Sterman, 2000).

The route system's interdependencies and feedback loops can be found using system theory. Instead of concentrating only on individual parts, managers can maximize

the system's performance by comprehending these relationships. For instance, more efficient operations and improved organizational performance might arise from considering the impact of driver scheduling on both vehicle maintenance and productivity.

Strategically determining the most economical and efficient routes for transportation operations while accounting for a variety of variables, including distance, traffic, delivery schedules, and vehicle capacity, is known as route planning management. According to Ambrosino and Sciomachen (2013), it entails optimizing route selection and sequencing in order to reduce transportation costs, increase delivery speed, and maximize resource utilization. Route planning, according to Cordeau et al. (2010), is the process of organizing delivery orders to produce an effective path that visits each stop in the lowest amount of time while taking delivery windows, traffic, and distance into account.

Advanced technologies, algorithms, and data analysis are used by route planning management to find the best routes and make necessary real-time adjustments. It assists companies in improving on-time delivery performance, cutting fuel consumption, lowering vehicle maintenance expenses, streamlining transportation operations, and increasing overall productivity. Reduced transportation expenses, increased operational effectiveness, better fleet utilization, a smaller carbon footprint, and heightened market competitiveness are just a few advantages that businesses can reap from efficient route planning management. This helps to reduce unnecessary mileage (Button, 2018). Agro-allied businesses benefit from lower fuel and vehicle maintenance costs as a result (Yadav et al., 2016). Additionally, efficient route planning guarantees that agricultural supplies and products are delivered on time. It improves operating efficiency, cuts down on delivery delays, and streamlines transportation processes. As a result, supply chain interruptions are minimized, inventory holding costs are decreased, and production planning is enhanced (Paul et al., 2016). Route planning enhances transportation operations, allowing agro-allied businesses to save money, increase operational effectiveness, and provide a better customer experience (Nnaji, 2020). These elements support increased competitiveness and overall performance in the agro-allied sector.

2.3 Review of literature

The impact of route planning management on organizational performance in the logistics sector was examined by Zhang et al. (2020). Using an empirical research methodology, the study collected information on route planning procedures from a number of logistics firms. The findings showed a favorable correlation between enhanced organizational performance and efficient route planning management. Businesses saw even greater performance gains when they integrated cutting-edge technologies like machine learning algorithms and artificial intelligence into their route planning process.

Daskalakis (2022) investigated how route planning affects organizational performance, particularly in relation to logistics for cross-border e-commerce. Data was gathered from Chinese logistics and e-commerce businesses using a survey method. The results showed that effective management of route planning greatly improved organizational performance in terms of productivity, inventory control, delivery time, and cost reduction. The advantages of effective route planning management were further enhanced by advanced logistical capabilities and technologies.

The impact of transportation management systems on the supply chain performance of Fast-Moving Consumer Goods (FMCG) companies in Kenya was examined by Jepherson et al. in 2021. They polled operations managers from 51 Nairobi-based FMCG enterprises using a descriptive study design. Through the provision of trade

compliance data, transportation operations optimization, on-time delivery, visibility into daily operations, and shipping process simplification, the study discovered that transportation management systems had a significant and positive impact on supply chain performance. Using data from 150 companies, Fugate et al. (2010) studied logistics performance and how it affects company performance in the USA. According to their research, boosting the effectiveness and efficiency of logistics resulted in lower costs, inventory, and cash requirements while raising sales, line-item fill rates, inventory availability, and on-time and damage-free deliveries. In the end, these enhancements improved the firm's overall performance, net margin, asset turnover, and return on assets.

With a focus on Dangote Flour Mills Plc in Nigeria, Abdul et al. (2019) carried out a study to evaluate the impact of logistics management on organizational performance. To satisfy consumer needs and maintain growth, businesses take part in a variety of logistics-related operations. The study sought to accomplish the following goals: assess how inventory management affects organizational productivity, analyze how transport management affects organizational effectiveness, and investigate how information flow affects employee efficiency. A descriptive survey research design was used in the study, which polled 115 workers at the Dangote Flour Mills in Ilorin. The results showed that information flow management and employee efficiency have a strong relationship (R² value of 0.923), inventory management and organizational productivity have a strong relationship (Pearson correlation value of 0.859), and transportation management has a significant impact on organizational effectiveness (R² value of 0.769). The study suggested that in order to make a substantial contribution to the long-term growth of the Nigerian economy, logistics management considerations have to be included into organizational strategic plans”.

METHODS

Research Resign

The conceptual model indicates that route evaluation management improves organizational performance, but this effect depends on how well the practices of route evaluation management are matched with the unique requirements and difficulties of the South-South Nigerian agro-allied sector.

By ensuring that a situation was well described and that there was little bias in the data gathering process, a descriptive survey helped to minimize errors in data interpretation. The quantitative research design is a method for collecting data from study participants in a numerical manner, according to Christensen, Johnson, and Turner (2019) (Amaonye, Abang & Onuorah 2024). The descriptive survey method, a type of quantitative research strategy used for this study, enables researchers to collect information about an existing phenomena from a cross-section of the target population (Leedy & Ormrod, 2001). This design is employed because no effort is made to alter any of the variables in the study; instead, they are depicted among the participants as they actually are.

Study Area

The South-South region of Nigeria was the site of the study. Nigeria's Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers States are its six constituent states. which were employed in the research. Nonetheless, the study tried to include randomly chosen employees in the research area. Because of its abundant oil and gas resources, which make it a major contributor to Nigeria's economy, the study location was purposefully chosen. This is to ensure a fair outcome.

Population of the Study

The study's population consists of all 1,494 workers from the chosen agro-allied businesses in the six South-South states, which are Cross River, Edo, Delta, Bayelsa, Rivers, and Akwa-Ibom. Table 1 and Figure 1 show the total number of employees in each of the six agro-allied enterprises based on data gathered from their human resources departments.

Table 1. Population Distribution

| S/N | Agro-allied Companies | State | Population of Employees (Estimated) |
|--------------|----------------------------------|-------------|-------------------------------------|
| 1 | Saroafrica International Limited | Edo | 143 |
| 2 | Premier Feed Mills Limited | Delta | 274 |
| 3 | Crown Flour Mill Limited | Cross River | 183 |
| 4 | Flour Mill of Nigeria Plc | Cross River | 430 |
| 5 | Kings Flour Mill Limited | Akwa Ibom | 287 |
| 6 | Presco Plc | Edo | 177 |
| Total | | | 1,494 |

Source: Compiled by Eyo (2024) from Human Resources Department of the selected Agro-allied companies, 2025

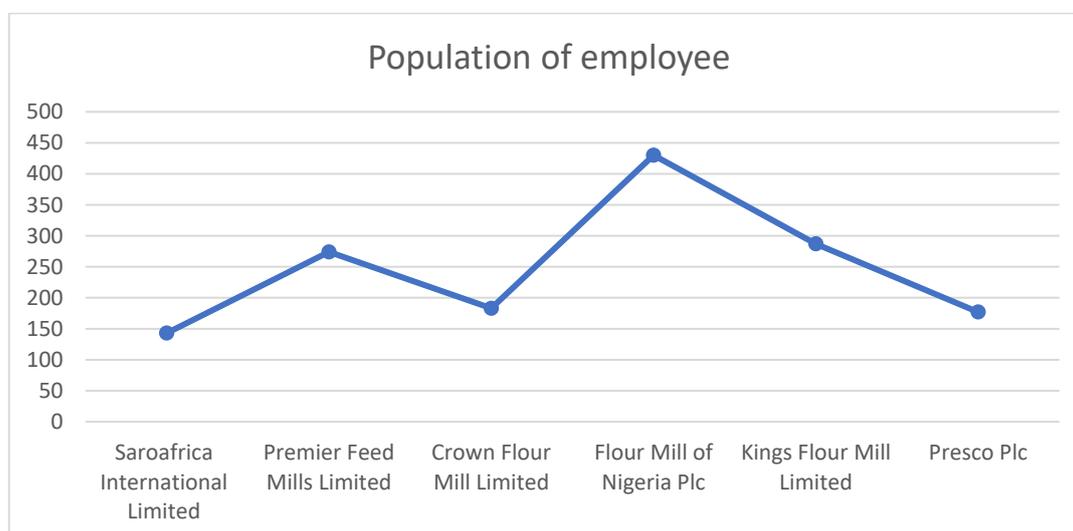


Figure 1. Population distribution

Source: Eyo (2024)

Sample size

The sample size was calculated using Yamane's formula with a confident level 95% and an error 5% ($P = 0.05$). This is as given below:

$$N = \frac{N}{1 + N(e)^2}$$

Where:

n = Sample size

N = Population size

e = error margin (alpha value)

$$n = \frac{1494}{1 + 1494(0.05)^2}$$

$$n = \frac{1494}{1 + 1494(0.0025)}$$

$$n = \frac{1494}{3.735}$$

$$n = 950$$

950 samples were acquired for this study using the formula. Samples were taken from the agro-allied businesses using proportionate stratified sampling. Both quantitative and qualitative methods were used in the investigation. A systematic questionnaire was employed in the investigation. The questionnaire was designed to determine the degree to which organizational performance and shipment evaluation management impact the economic growth of agro-allied businesses in South-South, and consequently, Nigeria.

Validity of the Instrument

Validity in a study refers to how effectively the data gathered covers the real field of study. Measure what is meant to be measured, is the core meaning. The degree to which a research tool measures what it is intended to measure is known as validity. The Content Validity test was employed in this study. The degree to which an assessment tool is reflective of and pertinent to the intended construct it is intended to test is known as content validity. By examining how far the instrument measures the intended building, the content validation process which is essential to creating any new instrument proves the validity of the tool. This makes it possible to utilize the instrument to draw conclusions and make decisions based on the results that are acceptable and useful for the assessment's goal. A copy of the questionnaire, along with a copy of the study that included the problem statement, study purpose, research questions, and hypotheses, was sent to some subject-matter experts to verify that it measures what it is supposed to measure. They checked the questionnaire's face validity by making sure that all words and items that could confuse the respondent filling it out or that had to do with the instrument were changed or removed. Also, to make sure the instrument included the majority, if not all, of the subject matter that ought to be covered in the questionnaire, and also examined the content validity.

Reliability of the Instrument

A test instrument's reliability is the extent to which the study methodology yields consistent and stable results. It is the capacity to yield comparable outcomes when measurements are taken repeatedly under the same circumstances (Bordens & Abbot, 2002). If a certain measure yields consistent results when used to the same item of measurement a number of times, it is deemed dependable. Retest reliability is another name for dependability. It tracks the consistency of tests over time. The same responder received the identical questionnaire at several points in time. To check if the scores are the same, this is done. Test-retest reliability coefficients also called coefficients of stability vary between 0 and 1; where: 1 = perfect; ≥ 0.9 = excellent; $\geq 0.8 < 0.9$ = acceptable; $\geq 0.6 < 0.7$ = questionable; $\geq 0.5 < 0.6$ = poor; < 0.5 = unacceptable; 0 = no reliability. The reliability for the research study was determined using the test re- test method. The Spearman Rank Order correlation formula was then used to correlate the produced data. The reliability of the data was assessed using the Cronbach's alpha test. The well-known test for determining item consistency is the Cronbach's alpha coefficient.

Data Analysis

Both descriptive and inferential statistics were used to analyze the data. The Statistical Package for Social Sciences (SPSS V26) and E-views were utilized. Because the data to be used in the data analysis was quantitative, these were preferred. Additionally, pre-post intervention changes within the intervention group were evaluated using inferential statistics in comparison to the control group. The study

found these descriptive statistical tools useful for characterizing the data and its noteworthy features. The demographic information of employees of agro-allied businesses was also analyzed using frequency and percentage, and the effect of organizational performance and shipment evaluation management on economic growth was ascertained using multilinear regression analysis.

A multiple linear regression model was used to determine the influence of shipment evaluation and organisational performance on economic growth.

The model is specified as follows:

$$OP = f (RPM, TAX, ID, LF)$$

Presenting the above equation in a more explicit econometric form can be expressed as below:

$$OP_t = \beta_0 + \beta_1t + \beta_2RPM_t + \beta_3TAX_t + \beta_4ID_t + \beta_5LF_t + \beta_6INF_t + \epsilon_t$$

The above equation will be use to solve objective 2

Where:

OP = Organisational performance

β_0 = Constant term

RPM = Route planning management

TAX = Tax compliance proxy for Government policies and regulations

ID = Infrastructural development

LF = Labor force proxy for firm size

INF = Inflation measured in per cent

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are parameters to be estimated

t = time dimension

ϵ_i = Error term

RESULTS AND DISCUSSION

Distribution of Respondents

A total of 965 copies of questionnaire were administered to respondents in the six selected agro-allied companies to obtain responses on route management and organisational performance. Out of 965 copies of questionnaire distributed, 950 copies of the questionnaire were retrieved, representing 98.45 per cent while a total of 15 copies of the questionnaire were not returned representing 1.55 per cent. Table 4 shows the breakdown of questionnaire distribution, returned, and not returned rate and per centile rate of retrieval and not retrieved in the selected companies.

Table 2 indicates that out of 105 copies of the questionnaire distributed in Saroafrica International, 102 copies were retrieved representing 97.14 per cent, while three copies were not returned representing 2.86 per cent. Out of 162 copies of the questionnaire distributed in Premier Feed Mills, 160 copies were retrieved representing 98.76 per cent returned rate, while a total of two copies representing 1.24 per cent were not returned. Similarly, out of 125 copies of the questionnaire distributed in Crown Flour Mill Limited, 122 copies representing 97.60 per cent were retrieved while three copies representing 2.40 per cent were not returned. In Flour Mill of Nigeria Plc, table 4 indicated that out of 207 copies of the questionnaire distributed, two copies were retrieved representing 99.03 per cent returned rate in the company while two copies were not returned representing 0.97 per cent. Also, in Kings Flour Mill Limited, out of 244 copies of the questionnaire distributed, 241

copies representing 98.77 per cent were retrieved while three copies representing 1.22 per cent were not returned. Similarly, in Presco Plc, Table 4 revealed that out of 122 copies of the questionnaire distributed in the Company, 120 copies were retrieved representing 98.36 per cent returned rate in the company while two copies were not returned representing 1.64 per cent.

Table 2. Distribution and Returned Rate Of Questionnaire

| S/N | Selected Companies | Copies of questionnaire administered | Copies of questionnaire returned | Copies of questionnaire not returned | Returned percentage | Percentage not returned | Total percentage |
|-----|---------------------------|--------------------------------------|----------------------------------|--------------------------------------|---------------------|-------------------------|------------------|
| 1 | Sarofafrica International | 105 | 102 | 3 | 97.14 | 2.86 | 100 |
| 2 | Premier Feed Mills | 162 | 160 | 2 | 98.76 | 1.24 | 100 |
| 3 | Crown Flour Mill Limited | 125 | 122 | 3 | 97.60 | 2.40 | 100 |
| 4 | Flour Mill of Nigeria Plc | 207 | 205 | 2 | 99.03 | 0.97 | 100 |
| 5 | Kings Flour Mill Limited | 244 | 241 | 3 | 98.77 | 1.22 | 100 |
| 6 | Presco Plc | 122 | 120 | 2 | 98.36 | 1.64 | 100 |
| | Total | 965 | 950 | 15 | 98.45 | 1.55 | 100 |

Source: Fieldwork, 2025

Table 3 shows the demographic characteristics distribution of respondents in the selected agro allied firms. The table indicated that out of 950 respondents, 653 respondents representing 68.7 per cent were male, while 297 respondents representing 31.3 per cent were female. Data on age bracket of respondents shows that three age group made up most respondents, out of 950 respondents, 323 respondents representing 34.0 per cent were between 18-30 years of age; 401 respondents representing 42.2 per cent were between 31-40 years of age; and 179 respondent representing 18.8 per cent were between the age bracket of 41-50 years while 47 “respondents representing 4.9 per cent were 51 years and above of age.

Data on the marital status of respondents from table 5 reveals that a large majority of the respondents were married. However, out of 950 respondents, 385 respondents representing 40.5 per cent were single; 525 respondents representing 55.3 per cent were married; 31 respondents representing 3.3 per cent were divorce while nine respondents representing 0.9 per cent were widow/widower. Data on educational qualification of respondents from table 5 indicates that the bulk of the participants were holders of HND/B.Sc. Out of 950 respondents, 198 respondents representing 20.8 per cent were SSCE/NECO or GCE holders; 223 respondents representing 23.5 per cent were OND/NCE holders, and 421 respondents representing 44.3 per cent were holders of HND/B.Sc; 70 respondents representing 7.4 per cent were holders of MBA/M.Sc; while 38 respondents representing 4.0 per cent were holders of other qualifications.

Table 3. Demographic Distribution of Respondents

| S/N | Items | Number of respondents | Percentage |
|-----|-------------|-----------------------|------------|
| 1 | Sex | | |
| | Male | 653 | 68.7 |
| | Female | 297 | 31.3 |
| | Total | 950 | 100 |
| 2 | Age bracket | | |
| | 18-30 | 323 | 34.0 |
| | 31-40 | 401 | 42.2 |

| | | | |
|---|---------------------------|-----|------|
| | 41-50 | 179 | 18.8 |
| | 51 and above | 47 | 4.9 |
| | Total | 950 | 100 |
| 3 | Marital status | | |
| | Single | 385 | 40.5 |
| | Married | 525 | 55.3 |
| | Divorce/Separated | 31 | 3.3 |
| | Widow/widower | 9 | 0.9 |
| | Total | 950 | 100 |
| 4 | Educational qualification | | |
| | SSCE, NECO or GCE | 198 | 20.8 |
| | OND/NCE | 223 | 23.5 |
| | HND/B.Sc | 421 | 44.3 |
| | PGD, MBA/M.Sc | 70 | 7.4 |
| | Others specify | 38 | 4.0 |
| | Total | 950 | 100 |

Source: Fieldwork, 2025

Preliminary analysis and data cleaning

This section focuses on data cleansing and preliminary analysis carried out in the study. The section presents the analysis of non-response bias, missing data, descriptive statistics of the constructs utilized in the study, outliers test, normality test, linearity test, homoscedasticity test, serial correlation test, and multicollinearity test.

Non-response bias analysis

A total of 950 questionnaires were used for analysis. Out of these, 502 questionnaires, which represents 52.84 per cent of the total, were retrieved within the first month of questionnaire administration. These early responses were labelled as the "early response group. The remaining 448 questionnaires, representing 47.16 per cent, were retrieved in the last three weeks of the questionnaire administration, and were designated as the "late response group. To facilitate the analysis of non-response bias, the early response group and the late response group were separated and coded as one and two, respectively. This coding allowed for a clear distinction between the two groups during further analysis.

To determine if there was a significant difference between the mean values of the early response group and the late response group, an independent sample t-test was employed. The independent sample t-test is a statistical method used to compare the means of two independent groups and ascertain whether there is a statistically significant difference between them. After conducting the independent sample t-test and examining the results, it was found that the p-values obtained for all groups were greater than 0.05. This indicates that the two groups, i.e., the early and late response groups, are homogeneous. In other words, there was no significant mean difference between the early and late response groups based on the collected data from the questionnaires. Overall, this analysis suggests that there is no significant bias between the early and late respondents, and the data collected from both groups can be considered comparable for further analysis and interpretation.

Table 4. Non-Response Bias

| S/N | Variable | Group | N | Mean | Std. Deviation | Levene's Test for Equality of Variance | |
|-----|----------|-------|---|------|----------------|----------------------------------------|------|
| | | | | | | F | Sig. |
| | | | | | | | |

| | | | | | | | |
|---|---------------------------|----------------|-----|--------|---------|-------|-------|
| 1 | Route planning management | Early response | 502 | 4.2680 | 0.47552 | 0.181 | 0.188 |
| | | Late response | 448 | 4.0162 | 0.41851 | | |
| 2 | Operational efficiency | Early response | 502 | 4.1286 | 0.52101 | 0.323 | 0.455 |
| | | Late response | 448 | 4.1041 | 0.54121 | | |
| 3 | Lead time | Early response | 502 | 4.5016 | 0.40611 | 0.182 | 0.550 |
| | | Late response | 448 | 4.3500 | 0.50103 | | |
| 4 | Vehicle downtime | Early response | 502 | 4.2272 | 0.46352 | 0.278 | 0.522 |
| | | Late response | 448 | 4.1364 | 0.51671 | | |
| 5 | Quality product delivered | Early response | 502 | 4.0783 | 0.44172 | 0.315 | 0.503 |
| | | Late response | 448 | 4.0836 | 0.53514 | | |
| 6 | Productivity | Early response | 502 | 4.1212 | 0.41717 | 0.211 | 0.510 |
| | | Late response | 448 | 4.1773 | 0.54627 | | |
| 7 | Technology | Early response | 502 | 4.1036 | 0.44470 | 0.201 | 0.324 |
| | | Late response | 448 | 4.0658 | 0.51103 | | |

Source: Fieldwork, 2025

Descriptive statistics of variables

Table 5 provides a comprehensive overview of the descriptive statistics pertaining to the variables related to route management and the performance of agro-allied firms in the South-South region of Nigeria. The data used in this analysis was collected from a total of 950 respondents. The respondents were asked to rate their responses to the various items related to route management and performance on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The results show that the minimum rating for each variable was 1, representing a "strongly disagree" response, while the maximum rating was 5, indicating a "strongly agree" response.

The mean values for all the variables were found to be above 2.5, suggesting an overall positive response to the questions posed in the survey. This implies that, on average, the respondents tend to agree or strongly agree with the statements related to route management and the performance of agro-allied firms. Additionally, the standard deviations for all the variables were observed to be below 1. A low standard deviation signifies that the responses were closely clustered around the mean, indicating a relatively high level of agreement among the respondents. Furthermore, the variances, which describe the extent of dispersion or spread of the data, were reported to be adequate. This suggests that the responses were not overly concentrated around a specific point, but rather, they exhibited a reasonable level of variability, allowing for a more accurate representation of the respondents' perspectives on the subject matter. The results from Table 5 demonstrate that most of the respondents in the South-South region of Nigeria showed a positive inclination towards the questions related to route management and agro-allied firms' performance, with responses converging around the mean values and exhibiting an appropriate level of data spread. These findings provide valuable insights into the prevailing attitudes and perceptions within the surveyed population.

Table 5. Descriptive Statistics for the study variables

| Variables | N | Minimum | Maximum | Mean | Std. Deviation | Variance |
|---------------------------|-----|---------|---------|--------|----------------|----------|
| Route planning management | 950 | 1 | 5 | 4.3785 | .26641 | .071 |
| Lead time | 950 | 1 | 5 | 4.4038 | .38672 | .150 |
| Vehicle downtime | 950 | 1 | 5 | 4.3949 | .37431 | .140 |
| Quality product delivered | 950 | 1 | 5 | 4.3959 | .39255 | .154 |
| Productivity | 950 | 1 | 5 | 4.3846 | .38773 | .148 |
| Technology | 950 | 1 | 5 | 4.3552 | .31195 | .149 |
| Valid N (listwise) | 950 | | | | | |

Source: Fieldwork, 2026

Outliers analysis

Outliers can significantly impact the results of multivariate analysis and exert a disproportionate influence on regression outcomes. As part of the data cleaning process for the study's analysis, a thorough check was conducted to identify potential multivariate outliers. In accordance with the approach recommended by Hair et al. in 2010, the Mahalanobis Distance (D2) was utilized to assess the presence of outliers within the dataset. The Mahalanobis D2 assesses each observation's position in a multidimensional space relative to the mean center of all observations, yielding a single value for each observation (Hair et al., 2010). Subsequently, the Mahalanobis Distance values were compared to the Chi-square distribution with the same degrees of freedom. The results revealed that only one case exhibited Mahalanobis Distance probability values exceeding 0.001, signifying it as an outlier, and this particular case was removed from the dataset. The remaining 949 cases exhibited values lower than 0.001 and were retained, resulting in a dataset free from outliers.

Multivariate assumptions test

The last phase of data examination entails the evaluation of the fundamental assumptions that underlie the statistical foundations of multivariate analysis. In pursuit of this objective, various assessments were conducted to verify the accuracy and dependability of the results obtained from the regression analysis. These evaluations encompassed checks for normality, linearity, homoscedasticity, and multicollinearity.

Normality test

A test was conducted to check if the data-set followed a normal distribution, which is crucial for regression analysis, as suggested by Hair et al. (2010). They recommended that the skewness and kurtosis values should not exceed +2.58 and +7, respectively, for normally distributed data. To assess the distribution's normality, both statistical and graphical methods were used. The outcomes of the normality test, including computed skewness and kurtosis values for all variables in the study, are presented in Table 8. These results revealed that all variables met the normality condition, as their skewness and kurtosis values were within the recommended limits of +2.58 and +7 (as indicated in Table 6).

To further confirm the data-set's normality, two additional tests were performed: the KMO measure for sampling adequacy and Bartlett's Test. The KMO measure should exceed 0.6, and Bartlett's Test p-value should be less than 0.05. The results of these tests also affirmed that the data-set displayed normal characteristics. Additionally, a histogram (Figure 2) was employed as a graphical tool to visually examine the data-set's distribution. The histogram further supported the conclusion that the data-set exhibited a normal distribution. In summary, the normality test, along with the KMO

measure and Bartlett's Test, confirmed the data-set's normal properties, meeting the prerequisites for regression analysis. The graphical use of the histogram reinforced this observation, instilling confidence in the data's suitability for subsequent statistical Analyses.

Table 6. Normality test result showing the skewness and kurtosis for the “dataset.

| Variables | N | Skewness | | Kurtosis | |
|-------------------------------|--------------------|-----------|------------|-----------|------------|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Route planning management | 949 | -.201 | .079 | -1.071 | .159 |
| Lead time | 949 | -.781 | .079 | -.928 | .159 |
| Vehicle downtime | 949 | -.547 | .079 | -1.274 | .159 |
| Quality product delivered | 949 | -.732 | .079 | -1.040 | .159 |
| Productivity | 949 | -.684 | .079 | -1.153 | .159 |
| Technology | 949 | -.743 | .079 | -.933 | .159 |
| Valid N (listwise) | 949 | | | | |
| KMO of Sampling Adequacy. | | | .921 | | |
| Bartlett's Test of Sphericity | Approx. Chi-Square | | 17559.843 | | |
| | Sig | | .000 | | |

Source: SPSS Output, 2025

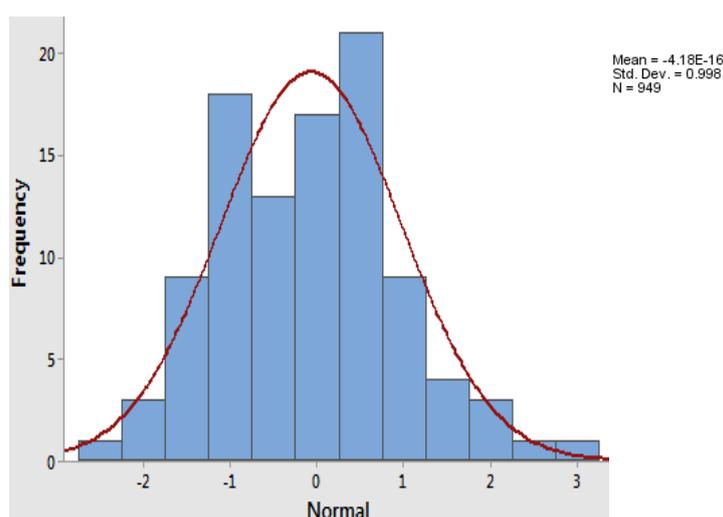


Figure 2. Histogram showing normality of data

Source: SPSS Output, 2024

Homoscedasticity test

Homoscedasticity refers to a condition where the variability of the dependent variable(s) remains consistent across the entire range of predictor variable(s). It is considered favorable because it ensures that the variance in the dependent variable explained by the relationship with the independent variable(s) is not concentrated within a limited range of independent values (Hair et al., 2010). To assess homoscedasticity, Levene's test for equality of variances was employed. The results presented in Table 9 indicate that Levene's test did not yield statistically significant differences among the variables ($p > 0.05$), suggesting that there is an even distribution of variance across all the variables.

Linearity test

To assess the linearity between the variables employed in this study, the researchers utilized the Correlation. The correlations among the variables are presented in Table 8. Additionally, the linearity of the variables was tested through the implementation of the normal probability plot (P-P). According to Hair et al. (2010), for a linear relationship to be established, the variables should closely follow the probability plot (P-P) line. Figure 3 visually demonstrates the findings, indicating that the variables indeed exhibit linear relationships. This conclusion is supported by the observations that the responses (represented by the dots) align closely with the regression line on the graph.

Table 7. Levene's test of homogeneity of variances

| Variables | Levene statistic | df1 | df2 | Sig. |
|---------------------------|------------------|-----|-----|------|
| Route planning management | .461 | 1 | 947 | .498 |
| Lead time | 1.916 | 1 | 947 | .237 |
| Vehicle downtime | 2.206 | 1 | 947 | .253 |
| Quality product delivered | 1.741 | 1 | 947 | .084 |
| Productivity | .443 | 1 | 947 | .452 |
| Technology | .622 | 1 | 947 | .421 |
| Valid N (listwise)949 | | | | |

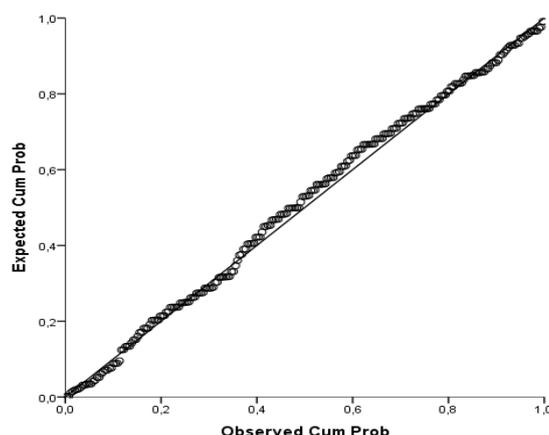
Source: SPSS Output, 2025

Table 8. Correlations among variables

| Constructs | RPM | FAM | Tec |
|---------------------------|--------|--------|-----|
| Route planning management | 1 | | |
| Freight audit management | .759** | 1 | |
| Technology | .842** | .773** | 1 |

** . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2025



Dependent Variable: Performance)

Figure 3. Normal probability plot showing linearity among constructs. (Normal P-P Plot of Regression Standardized Residual

Source: Author's computation from SPSS Output, 2025

Test for multicollinearity

In this study, a multicollinearity test was conducted to examine whether there were significant inter-correlations or inter-associations among the predictor variables. To assess multicollinearity, two key measures were "utilized: the tolerance value and

the VIF. The tolerance value represents the proportion of variance in a specific predictor variable that cannot be explained by the other predictor variables in the model. When tolerance values approach zero, it indicates a high degree of multicollinearity, which can lead to inflated standard errors of the regression coefficients. In such cases, the reliability of the coefficient estimates becomes compromised.

To identify a general guideline for assessing multicollinearity, researchers often rely on the following rule of thumb: the tolerance value should not fall below 0.1, and the VIF should not exceed 10 (Hair et al., 2010). When these thresholds are surpassed, it suggests the presence of problematic multicollinearity in the model. After conducting the multicollinearity test and examining the results presented in Table 9, it was observed that there were no significant multicollinearity issues in the dataset. The tolerance values for the predictor variable was above 0.1, indicating that a reasonable amount of variance was not accounted for by the other predictors. Additionally, the VIF values were well below the critical cut off value of 10 for all the models. Therefore, the analysis demonstrated that the predictor variable in the models did not suffer from high multicollinearity. Therefore, the regression coefficients were reliable, and the potential issues related to inflated standard errors were avoided, ensuring the validity of the results obtained from the analysis.

Table 9. Summary of Collinearity statistics of variables

| Variables | Collinearity Statistics | |
|---------------------------|-------------------------|-------|
| | Tolerance | VIF |
| Route planning management | .404 | 2.474 |

Source: SPSS Output, 2025

Exploratory factor analysis

Exploratory factor analysis describes the procedure involves in evaluating the structure of constructs in a study and data reduction technique necessary to streamline variables to a manageable number (Hair et al, 2010). Factor analysis is a statistical method used to describe variability among observed and correlated variables in terms of a potentially lower number of unobserved variables called factors. It is a data reduction technique which streamlines multiple variables into fewer ones that adequately represents the construct.

According to Hair et al (2010), the purpose of exploratory factor analysis is the reduction and summarization of data using either factor analysis or principal component analysis. However, to ascertain the content validity of the questionnaire constructs after the necessary preliminary data analysis were carried out, the exploratory factor analysis- PCA was performed. This was necessary because principal component analysis focuses on the minimum number of factors that accounts for the most variance in the variables and whose specific variance represents a small fraction of the variance in the variable. Similarly, in terms of factor rotation, the Orthogonal Varimax rotation was utilized because it offers a better delineation of factors (Hair et al, 2010). However, the number of factors to retain in the model is determined by the total variance explained and the Eigen values. The criteria for determining validity using principal component analysis is presented in Table 10.

Table 10. Criteria for assessing validity.

| S/N | Determinants | Assessment criteria |
|-----|--------------------------|---------------------|
| 1 | Inter correlations | >.30 |
| 2 | Kaiser-Meyer-Olkin (KMO) | >.50 |

| | | |
|---|-----------------------------------|--------------|
| 3 | Bartlett's test of sphericity | <.05 |
| 4 | Measure of sample adequacy | >.50 |
| 5 | Anti-image | >.50 |
| 6 | Factor loading (Component Matrix) | >.50 |
| 7 | Total variance explained | >60 per cent |
| 8 | Eigen values | >1 |

Source: Hair, Black, Babin & Anderson (2010)

Exploratory factor analysis on Route planning management

Using principal component analysis, the scales designed to measure Route planning management were extracted under three components based on Eigen values greater than 1 and Varimax with Kaiser Normalization rotation method. Factor loadings less than 0.5 were not reported and variables were sorted based on each factor loadings. The communalities were extracted for each scale and one scale RPM4 had a value less than the acceptable level of 0.5. All the extractions each had factor loadings from 0.5 as seen in Table 11a. The initial Eigen values showed that 65.809 per cent of the total variance is explained by the components. The table also shows that KMO was less than 0.5, thus indicating that the rule for sampling adequacy is violated. Notwithstanding, Bartlett's Test of Sphericity is significant (.000). RPM4 was deleted due to violation of the communality rule. Hence the principal component analysis was repeated.

Table 11b presents the result of the second PCA on inbound logistics. The table indicated that the factor loadings, communalities, and KMO were all above 0.5. Total variance explained by the scales was greater than acceptable level of 0.60 and Bartlett's Test was significant at (.000) thus indicating that the construct is suitable for structure detection.

Table 11. VARIMAX- Rotated factor loadings for Route planning management (Part 1)

| Scales | Component | | | Communality |
|------------------------------------|-----------|--------|--------|-------------|
| | 1 | 2 | 3 | |
| RPM1 | .905 | | | .843 |
| RPM2 | .824 | | | .712 |
| RPM3 | .753 | | | .673 |
| RPM4 | | .740 | | .599 |
| RPM5 | | .690 | | .492 |
| RPM6 | | | .804 | .810 |
| RPM7 | | | .665 | .690 |
| | | | | Total |
| Eigen values | 1.888 | 1.568 | 1.515 | 4.971 |
| Variance Explained | 26.769 | 22.107 | 16.933 | 65.809 |
| KMO of Sampling Adequacy = 0.484 | | | | |
| BTS/ Approx. Chi-Square = 1087.789 | | | | |
| Sig. = .000 | | | | |

Source: SPSS Output, 2025

Table 12. VARIMAX- Rotated factor loadings for Route planning management (Part 2)

| Scales | Component | | | Communality |
|--------|-----------|---|---|-------------|
| | 1 | 2 | 3 | |
| RPM1 | .887 | | | .832 |
| RPM2 | .834 | | | .709 |

| | | | | |
|-----------------------------------|--------|--------|--------|--------|
| RPM3 | .822 | | | .711 |
| RPM4 | | .814 | | .698 |
| RPM5 | | | .839 | .807 |
| RPM6 | | | .643 | .692 |
| | | | | Total |
| Eigen values | 1.888 | 1.383 | 1.109 | 4.380 |
| Variance Explained | 31.195 | 22.369 | 19.424 | 72.988 |
| KMO of Sampling Adequacy = 0.503 | | | | |
| BTS/ Approx. Chi-Square = 932.410 | | | | |
| Sig. = .000 | | | | |

Source: SPSS Output, 2025

The tests of the study hypotheses were based on the coefficients of the constructs in the specified model and the significance of the z-values as depicted in Tables 12 and 13. The probit model was preferred for interpretation and inference since Log likelihood Ratio value was lower than that of the logit model.

Table 13. Ordered logit and probit estimated results for the test of hypotheses between route planning management and organisational performance (Model A)

| Variable | Probit | | | Logit | | | Extreme value | | |
|-----------------------|--------|---------|-------|-------|---------|-------|---------------|---------|-------|
| | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. |
| RPM | 0.546 | 2.563 | 0.001 | 1.214 | 1.530 | 0.001 | 1.243 | 1.652 | 0.001 |
| FMM | 0.631 | 0.864 | 0.001 | 0.531 | 0.634 | 0.002 | 1.552 | 0.733 | 0.000 |
| WM | 0.563 | 1.954 | 0.003 | 1.431 | 1.672 | 0.000 | 0.298 | 1.974 | 0.002 |
| FAM | 0.834 | 2.536 | 0.000 | 1.232 | 1.634 | 0.000 | 1.263 | 1.745 | 0.000 |
| Pseudo R ² | | 0.676 | | | 0.696 | | | 0.686 | |
| LR statistic | | 57.58 | 0.000 | | 58.67 | 0.000 | | 61.541 | 0.000 |
| Akaike info criterion | | 3.845 | | | 3.877 | | | 3.892 | |

Source: Author's computation from SPSS Output, 2025

The study employed ordered probit and logit regression analyses to estimate the model and test the research hypotheses. The main focus was on assessing the significant relationship between route planning and the performance of agro-allied firms, with consideration of the moderating effect of technology. The primary "statistics of interest were the coefficients of the variables and their corresponding significance.

The researcher initially examined the relationship between the constructs of route management and the performance of agro-allied firms using the probit and logit approaches for model estimation. The Log Likelihood Ratio (LR) statistic was used to assess the model's performance, and the choice of the most appropriate model for interpretation depended on the LR values. The model with the lowest LR probability value or the higher LR coefficient was considered more reliable and was preferred for interpretation purposes. According to the results presented in Table 26, the probit model exhibited greater robustness compared to the logit model.

Specifically, the probit model had an LR value of 57.58, making it the preferred model for interpretation. This decision was further supported by the Akaike Information Criteria (AIC), where the probit model had the lowest AIC value of 3.845. The research findings indicated that the coefficients of SEM ($c = 0.813$, $z = 3.772$), RPM ($c = 0.546$, $z = 2.563$), FMM ($c = 0.631$, $z = 0.864$), WM ($c = 0.563$, $z = 1.954$), and FAM ($c = 0.834$, $z = 2.536$) were significant at the following p-values: 0.000, 0.001, 0.0001,

0.003, and 0.000, respectively. This implies that Route planning, serve as strong predictors of agro-allied firms' overall performance.

Table 14. Ordered Logit and probit results for route management and moderator (technology) (Model B)

| Variable | Probit | | | Logit | | | Extreme value | | |
|-----------------------|--------|---------|-------|-------|---------|-------|---------------|---------|-------|
| | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. |
| RPM | 0.646 | 2.564 | 0.002 | 1.214 | 1.530 | 0.001 | 1.243 | 1.654 | 0.002 |
| Tech | 0.755 | 1.945 | 0.000 | 1.635 | 1.843 | 0.001 | 1.329 | 1.853 | 0.000 |
| Pseudo R ² | | 0.776 | | | 0.786 | | | 0.796 | |
| LR statistic | | 65.57 | 0.000 | | 67.66 | 0.000 | | 68.52 | 0.000 |
| Akaike info criterion | | 3.793 | | | 3.812 | | | 3.878 | |

Source: SPSS Output, 2025

In examining the moderating effect of technology on route management and organisational performance in agro-allied industry in South-South, Nigeria. The study conducted a regression analysis estimating the relationship between route management and organisational performance in agro-allied firms, followed by regressing route management and the moderating variable (technology) and finally, estimating the relationship between route management, organisational performance, moderating variable (technology) and the interaction terms. The results of the estimations are presented in Tables 14, and 15. The results of the regression analysis of the effect of route management and organisational performance shown in Table 14 was significant RPM ($c = 0.546$, $z = 2.563$), was significant at the p-values: 0.002 significant level.

Furthermore, when technology was added to the model (see Table 15, Model B), the results were still significant for, RPM { $c = 0.646$, $z = 2.564$ }, and Tech { $c = 0.755$, $z = 1.945$ } with p-values of {0.002, and 0.000}. Also, when the interaction terms were added to the model (see Table 16 Model C), the results were also significant for SEM*Tech { $c = 0.655$, $z = 0.546$, $p = 0.002$ }, RPM *Tech { $c = 0.564$, $z = 0.763$, $p = 0.001$ }, FMM *Tech { $c = 0.654$, $z = 0.754$, $p = 0.002$ }, WM *Tech { $c = 1.874$, $z = 0.763$, $p = 0.002$ }, and FAM*Tech { $c = 0.855$, $z = 0.843$, $p = 0.001$ }. Also, table 15 shows the R² change statistic of 0.610, 0.665 and 0.706; F change statistics of 8.921, 9.653 and 9.543 and a p-value of 0.000**for model A, B and C respectively. This result implies that technology have a significant moderating effect on the relationship between route management and the organisational performance agro allied firms.

Table 15. Ordered logit and probit estimated results for independent, dependent, moderating variables and interaction term (Model C)

| Variable | Probit | | | Logit | | | Extreme value | | |
|-----------------------|--------|---------|-------|--------|---------|-------|---------------|---------|-------|
| | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. | Coef. | z-Stat. | Prob. |
| RPM | 0.582 | 4.532 | 0.001 | 0.621 | 2.334 | 0.001 | 0.662 | 4.135 | 0.002 |
| Tech | 0.843 | 5.632 | 0.000 | 1.621 | 3.432 | 0.000 | 0.743 | 4.674 | 0.000 |
| RPM*Tech | 0.564 | 0.763 | 0.001 | 0.513 | 0.531 | 0.002 | 0.511 | 0.831 | 0.002 |
| FMM*Tech | 0.654 | 0.754 | 0.002 | 0.561 | 1.621 | 0.002 | 0.531 | 0.668 | 0.001 |
| WM*Tech | 1.874 | 0.763 | 0.001 | 0.632 | 1.231 | 0.000 | 0.651 | 0.754 | 0.001 |
| FAM*Tech | 0.855 | 0.843 | 0.000 | 0.532 | 1.342 | 0.000 | 0.551 | 0.754 | 0.001 |
| Pseudo R ² | 0.565 | | | 0.584 | | | 0.592 | | |
| LR statistic | 51.431 | | | 54.423 | | | 56.372 | | 0.000 |
| Akaike info criterion | 3.473 | | 0.000 | 3.732 | | 0.000 | 3.543 | | |

Source: SPSS Output, 2025

Route planning management and organisational performance (lead time) of Agro-Allied firms shows that Route planning management does not have significant effect on the organisational performance (lead time) of Agro-Allied firms in South-South, Nigeria.

The estimated result in revealed that Route planning management have significant effect on the organisational performance (lead time) of Agro-Allied firms in South-South, Nigeria. This result was based on the coefficient of the variable which indicated values of RPM ($c = 0.546$, $z = 2.563$) and a probability value of 0.001.

The coefficient of Route planning management was positive with a significant p-value of 0.001. Based on this result, the null hypothesis was rejected in favour of the alternative hypothesis. This result implies that Route planning management have significant effect on the organisational performance (lead time) of Agro-Allied firms. This result agrees with the finding of Yadav et al. (2016) who found that efficient route planning can lead to reduced lead times for delivering products from the agro-allied firms to their customers. By identifying the most optimal routes and transportation methods, companies can minimise travel time and delays, ensuring that goods reach their destination faster. This can result in improved customer satisfaction, increased order fulfilment, and a competitive advantage in the market.

Similarly, Stopford and McKinnon (2019) found that effective Route planning management can lead to cost savings for agro-allied firms. By reducing the distance travelled, fuel consumption, and vehicle wear and tear, companies can lower their operational expenses. Additionally, faster lead times can result in reduced inventory holding costs and more efficient resource utilization, contributing to overall cost efficiency. Again, Oluwafemi (2023) study found that a well-optimised route planning and management system can give agro-allied firms a competitive advantage in the market. The ability to deliver products faster than competitors can attract new customers and retain existing ones. It can also help agro-allied firms expand their market reach, enter new territories, and gain a stronger foothold in the industry.

CONCLUSION

This study delved into route planning management and its impact on the organisational performance of Agro-Allied firms in South-South, Nigeria. The findings from this research shed light on the critical role that route management practices and technology play in driving operational efficiency, productivity, and overall success in the agro-allied industry. The study highlighted the significant effect of Route planning management on the lead time of Agro-Allied firms. Optimising route planning results in reduced travel time, faster deliveries, and improved customer service. With more efficient route planning strategies, companies can achieve cost efficiency and strengthen their market position by delivering products in a timely and reliable manner. Embracing technology and data-driven decision-making in route planning is crucial for enhancing overall productivity and customer satisfaction

Based on the findings from the study, the following recommendations were made:

Agro-allied firms should prioritize investment in Route planning management. Utilizing advanced route planning software, GPS tracking, and data analytics will help optimise transportation routes, reduce travel time, and streamline delivery processes. Regularly updating route plans based on real-time data and market conditions will enable firms to achieve cost efficiency, faster lead times, and improved customer service. Embracing technology-driven route planning will ultimately lead to a competitive advantage in the industry.

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