Mobility Exclusion and Failed Essential Travel in Rural Public Transport Planning: Evidence from the Municipality of Sibuco, Zamboanga del Norte

Junievin RAMILLANO[a], Marlon Grande[b]

[a] *National Graduate School of Engineering, University of the Philippines Diliman, Quezon City, Metro Manila, 1101, Philippines*
[b] *College of Engineering, Western Mindanao State University, Normal Road Baliwasan, Zamboanga City, 7000, Philippines*
[a] *E-mail: jrramillano@up.edu.ph*
[b] *E-mail: grande.marlon@wmsu.edu.ph*

Abstract: Conventional public transport planning relies primarily on observed travel demand, potentially overlooking individuals whose mobility needs remain unmet because of transport-related barriers. This study examines the determinants of failed essential trips as an indicator of transport-related mobility exclusion in the Municipality of Sibuco, Zamboanga del Norte, Philippines. Household accessibility and Origin–Destination survey data collected during the preparation of the Local Public Transport Route Plan (LPTRP) were analyzed using binomial logistic regression. More than half of the respondents (54.1%) reported experiencing at least one failed essential trip in the previous month. The analysis identified distance to the nearest main road, public transport service frequency, difficulty accessing public transport, and road conditions as significant predictors of failed essential trips, whereas socioeconomic characteristics were not statistically significant. The findings demonstrate that failed essential trips complement conventional Origin–Destination analysis by revealing suppressed travel demand and providing an accessibility-oriented indicator for identifying underserved communities and informing more equitable rural public transport planning.

Keywords: *Mobility Exclusion; Failed Essential Trips; Rural Transport Planning; Transport Accessibility; Binomial Logistic Regression; Local Public Transport Route Plan (LPTRP)*

1. INTRODUCTION

Mobility is a fundamental requirement for accessing employment, education, healthcare, markets, and government services. For many communities, particularly those located in rural areas, public transportation serves as the primary means of connecting people to these essential opportunities (Berg & Ihlström, 2019). Thus, transport systems play a critical role not only in facilitating movement but also in promoting social inclusion, economic participation, and equitable access to basic services.

Conventional transport planning has largely focused on understanding travel demand through indicators such as Origin–Destination (OD) patterns, traffic volumes, passenger counts, travel time, and mode choice (Berg & Ihlström, 2019; Burgalat et al., 2026). These indicators provide valuable information on where people travel, how frequently they travel, and the routes they use. Such information forms the basis for forecasting demand, designing transport networks, and allocating transport services. However, these approaches inherently observe only trips that

have already occurred, overlooking individuals who were unable to travel because transport services were unavailable, inaccessible, unreliable, or unaffordable.

This limitation is particularly important in rural municipalities, where dispersed settlements, limited transport services, poor road conditions, and irregular operations often constrain mobility. In these settings, the absence of observed trips does not necessarily indicate the absence of transport demand. Rather, it may reflect unmet mobility needs, where individuals postpone, cancel, or completely forgo essential trips because of transport-related barriers. Such situations represent a form of mobility exclusion, wherein transport constraints prevent individuals from participating fully in economic and social activities despite their need to travel.

In the Philippines, the preparation of Local Public Transport Route Plans (LPTRPs) has provided local government units with an evidence-based framework for planning public transport services. LPTRPs typically utilize Origin–Destination surveys, passenger load counts, traffic counts, and operational inventories to determine route alignments and service requirements. While these datasets effectively identify existing travel demand, they provide limited information regarding residents who fail to reach essential destinations because transport services are inadequate or unavailable. Transport interventions based solely on completed trips may inadvertently overlook geographically isolated communities and underserved populations whose mobility needs remain unobserved.

The Municipality of Sibuco in Zamboanga del Norte exemplifies this challenge. Characterized by dispersed settlements, mountainous terrain, coastal communities, and limited formal public transport services, many residents rely on irregular transport operations to access schools, health facilities, markets, government offices, and employment centers. During the preparation of the municipality's Local Public Transport Route Plan, a household accessibility survey was conducted alongside the conventional Origin–Destination survey. In addition to collecting travel demand information, the survey documented residents' experiences of unsuccessful travel. This information provided a direct measure of transport-related mobility exclusion that is rarely incorporated into conventional transport planning studies.

Rather than treating failed trips merely as an accessibility outcome, this study argues that they provide complementary planning evidence capable of revealing unmet travel demand that conventional Origin–Destination surveys cannot capture. Understanding why essential trips fail enables transport planners to identify service deficiencies that remain hidden when planning decisions are based exclusively on observed passenger movements. Such evidence is particularly valuable in rural municipalities, where accessibility considerations may be equally as important as passenger demand in determining priority transport interventions. Thus, this study aims to identify the transport-related factors associated with failed essential trips in the Municipality of Sibuco, Zamboanga del Norte, using binomial logistic regression analysis. Specifically, the study examines how transport accessibility characteristics and selected socioeconomic variables influence the likelihood of experiencing a failed essential trip and demonstrates how failed essential trips can complement conventional Origin–Destination analysis in supporting accessibility-oriented Local Public Transport Route Planning (LPTRP).

2. LITERATURE REVIEW

2.1 Accessibility and Mobility Exclusion

Accessibility has long been recognized as one of the primary objectives of transport planning. Unlike mobility, which focuses on the movement of people and vehicles, accessibility emphasizes the ability of individuals to reach opportunities such as employment, education, healthcare, markets, and public services. Contemporary transport planning increasingly recognizes that improving accessibility, rather than simply increasing mobility, is essential for achieving equitable and inclusive transport systems (Geurs & van Wee, 2004; Lucas, 2012).

Mobility exclusion occurs when individuals experience transport-related barriers that prevent them from participating in economic and social activities. These barriers may arise from limited transport availability, long waiting times, unaffordable fares, poor infrastructure, safety concerns, or inadequate transport coverage (Lucas, 2012). Thus, transport disadvantage extends beyond inconvenience and may result in reduced access to employment, education, healthcare, and other essential opportunities, particularly among vulnerable populations and geographically isolated communities.

Previous studies have shown that accessibility is influenced by both transport supply and land-use characteristics. Rural areas frequently experience lower accessibility due to dispersed settlements, longer travel distances, and limited public transport services (Jamei et al., 2022). These conditions increase the likelihood that residents experience transport disadvantage despite relatively low observed travel demand.

2.2 Failed Essential Trips as an Indicator of Mobility Exclusion

Traditional transport analyses primarily examine trips that have already occurred. Origin–Destination surveys, passenger counts, and travel diaries provide valuable information regarding observed travel behavior but offer limited insight into trips that were intended but never completed. The concept of unmet travel demand recognizes that individuals may postpone, modify, or completely cancel trips because transportation is unavailable, unreliable, unsafe, or unaffordable (Lucas, 2012). Such unrealized travel represents an important dimension of mobility exclusion because the absence of observed travel does not necessarily imply the absence of travel need.

For this study, a failed essential trip refers to an intended trip to access an essential activity or destination that was not successfully undertaken or completed because of a transport-related constraint. Essential travel refers to travel necessary to access basic activities and opportunities, such as employment, education, healthcare, markets, and government services. A failed essential trip therefore represents an unmet travel need: the need or intention to travel existed, but the corresponding trip did not materialize because transport conditions prevented the individual from reaching the intended essential activity or destination.

Failed essential trips provide a direct manifestation of unmet travel demand. Rather than measuring perceptions of accessibility alone, they capture actual instances in which individuals were unable to reach important destinations because of transport-related constraints. This distinction is particularly important because transport planning based exclusively on completed trips may underestimate accessibility needs in communities where transport barriers discourage travel altogether.

Despite increasing interest in transport equity and accessibility, empirical studies explicitly examining failed essential trips remain limited, particularly within developing countries and rural municipalities. Most accessibility studies continue to focus on travel time, mode choice, or perceived accessibility, leaving a gap in understanding the transport factors associated with unsuccessful travel.

2.3 Rural Public Transport Planning

Rural public transport systems differ substantially from their urban counterparts. Lower population densities, dispersed settlements, limited financial resources, and weaker transport markets often result in irregular service provision and dependence on informal or demand-responsive transport services (Delbosc & Currie, 2011). Thus, planning approaches developed for urban environments may not adequately capture the accessibility needs of rural communities.

Conventional public transport planning typically prioritizes corridors with high passenger demand to maximize operational efficiency. While this approach is appropriate in densely populated urban areas, it may inadvertently disadvantage rural communities where travel demand is dispersed but access to essential services remains equally important. Several researchers have therefore argued that rural transport planning should balance operational efficiency with accessibility and social inclusion, particularly for communities experiencing transport disadvantage (Hine, 2004; Lucas, 2012).

The increasing adoption of evidence-based transport planning, including the use of Origin–Destination surveys and travel demand analysis, has improved the technical basis for route planning. However, these approaches continue to rely primarily on observed travel behavior and may overlook accessibility problems experienced by individuals who are unable to travel because transport services are inadequate.

2.4 Research Gap

The reviewed literature demonstrates that accessibility has become an increasingly important objective of transport planning, particularly in addressing transport disadvantage and promoting equitable access to essential opportunities. Previous studies have shown that inadequate transport services, poor infrastructure, dispersed settlements, and limited service availability contribute to mobility exclusion, especially within rural communities. Despite these advances, transport planning continues to rely predominantly on observed travel behavior, including Origin–Destination surveys, passenger counts, and travel diaries. While these methods effectively describe realized travel demand, they provide limited insight into individuals whose travel needs remain unmet because of transport-related barriers. As a result, mobility exclusion may be underestimated when transport planning is based solely on completed trips. This limitation underscores the need for complementary indicators capable of capturing suppressed or unrealized travel demand. One such indicator is failed essential trips, which directly measures transport-related mobility exclusion by identifying instances in which individuals are unable to reach important destinations because of deficiencies in the transport system.

This study addresses this gap by examining the determinants of failed essential trips using household accessibility survey data collected during the preparation of a Local Public Transport Route Plan in the Municipality of Sibuco, Zamboanga del Norte. Using Binary Logistic Regression, the study identifies the transport-related factors associated with unsuccessful travel

and demonstrates how failed essential trips can supplement conventional Origin–Destination analysis in identifying priority transport interventions. In doing so, the study contributes to rural transport planning by providing empirical evidence that accessibility-support routes may be justified not only by observed passenger demand but also by previously unobserved mobility needs.

3. METHODOLOGY

3.1 Study Area

The study was conducted in the Municipality of Sibuco, Zamboanga del Norte, Philippines, an administrative map is presented in Figure 1. Sibuco is a predominantly rural municipality characterized by dispersed settlements, mountainous terrain, coastal communities, and limited public transport services. The municipality relies largely on informal and low-capacity transport modes to provide access between barangays and the municipal center. For longer-distance regional trips, travel primarily depends on connectivity to Barangay Labuan, which is a major coastal barangay located in the northwestern area of Zamboanga City that serves as a primary transit gateway, and onward to the urban city center of Zamboanga. These characteristics make Sibuco an appropriate case for examining mobility exclusion resulting from transport accessibility constraints.

The study formed part of the data collection activities undertaken during the preparation of the Municipality's Local Public Transport Route Plan (LPTRP), providing an opportunity to integrate conventional travel demand data with household accessibility information.

3.2 Data Collection

Primary data were collected through a structured household survey administered across selected barangays in the Municipality of Sibuco. The survey formed one component of the municipality's LPTRP data collection program and consisted of two complementary modules: (1) an Origin–Destination (OD) survey and (2) a Household Accessibility Survey. The Origin–Destination survey collected information on respondents' travel behavior, including trip origins and destinations, trip purposes, travel frequency, and transport mode used. Meanwhile, the Household Accessibility Survey gathered information on transport service availability, accessibility conditions, transport affordability, road conditions, vehicle ownership, and respondents' experiences with transport-related constraints.

A total of 329 respondents were included in the study. The distribution of respondents across the surveyed barangays was determined using proportionate allocation based on barangay population size. The population of each barangay was expressed as a proportion of the total population covered by the survey, and the resulting proportion was used to determine the number of respondents allocated to each barangay. Consequently, barangays with larger populations were assigned a correspondingly larger number of respondents, while those with smaller populations were assigned fewer respondents. No separate quotas or stratification based on sex, age, income, or other socioeconomic characteristics were applied; therefore, the socioeconomic characteristics presented in the study reflect the observed composition of the surveyed respondents.

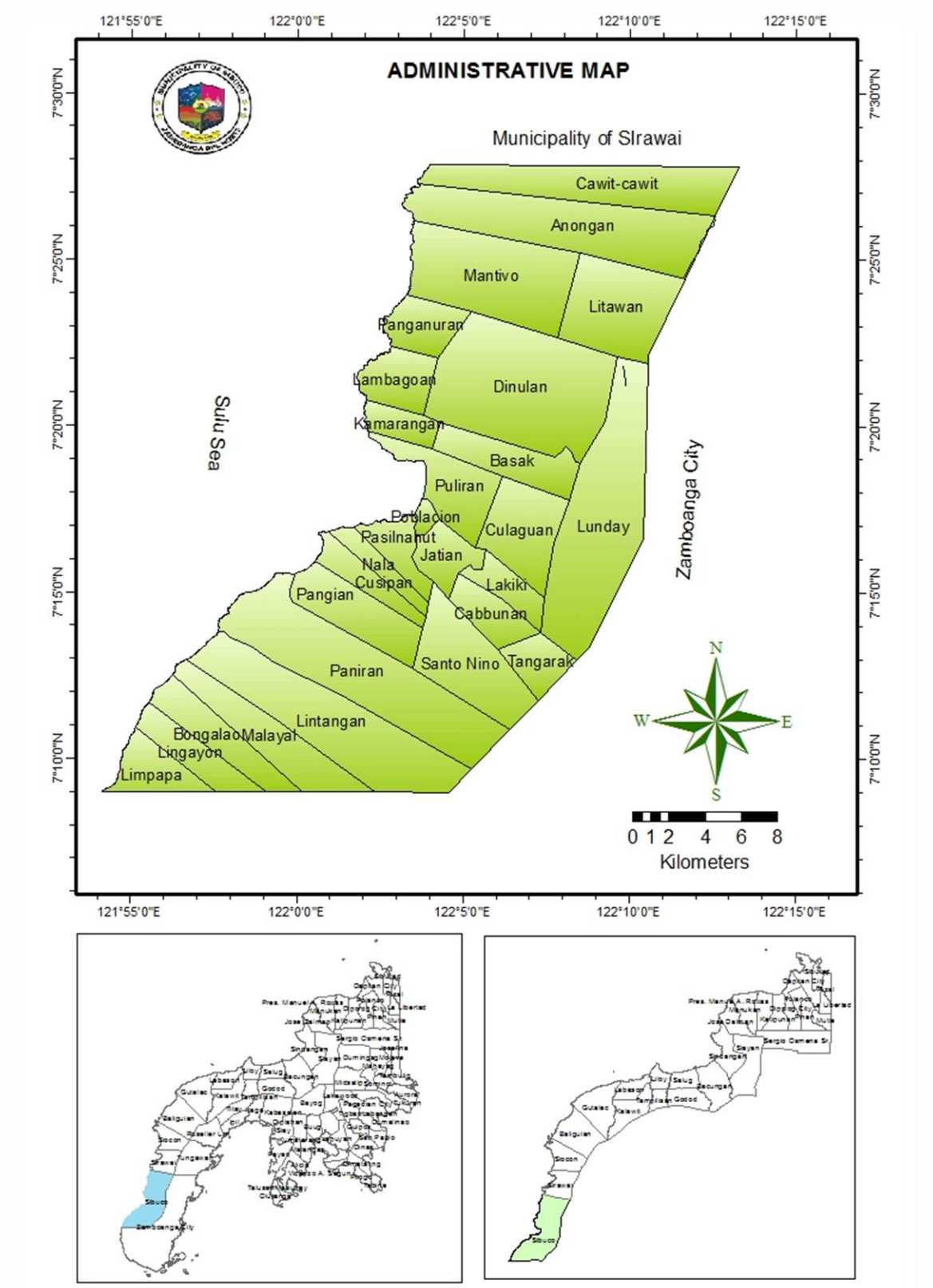


Figure 1. Administrative map of Municipality of Sibuco [Image Source: CLUP of Sibuco]

3.3 Variable Definition

3.3.1. Dependent Variable

The dependent variable was Failed Essential Trip (FET), used as an indicator of transport-related mobility exclusion. In this study, failed essential travel refers broadly to the phenomenon of being unable to undertake necessary travel because of transport-related constraints, whereas a failed essential trip refers to an individual occurrence of such travel failure. A failed essential trip was defined as an intended trip to access an essential activity or destination that was not successfully undertaken or completed because of a transport-related constraint. Essential travel included travel associated with activities such as employment, education, healthcare, markets, government services, and other necessary activities.

The occurrence of failed essential trips was obtained through the Household Accessibility Survey. Respondents were asked: *"In the past month, how many times did you fail to reach an important destination because of transport issues?"* Thus, the survey used a one-month recall period and elicited the number of reported failed essential trips experienced by each respondent. For the present analysis, these responses were transformed into a binary measure, whereby respondents reporting at least one occurrence during the recall period were classified as having experienced a failed essential trip.

The dependent variable was therefore coded as:

$$FET_i = \begin{cases} 0, & \text{if respondent } i \text{ reported no failed essential trip during the previous month} \\ 1, & \text{if respondent } i \text{ reported one or more failed essential trips during the previous month} \end{cases}$$

Although the survey elicited the number of failed essential trips reported during the preceding month, the present analysis used these responses to measure the incidence of failed essential travel at the respondent level (i.e., whether at least one failed essential trip occurred), rather than the frequency or total volume of failed trips. The survey also did not determine the number of successive attempts made to undertake a particular essential trip before it was eventually completed. The binary FET variable should therefore be interpreted as an indicator of whether a respondent experienced transport-related failure in undertaking essential travel during the one-month recall period, rather than as an estimate of the total number of unserved trips.

3.3.2. Independent Variables

The explanatory variables were selected based on transport accessibility literature and the availability of data from the household accessibility survey. These variables represented both transport service characteristics and household accessibility conditions.

For purposes of model development, the variables were organized into two groups: socioeconomic characteristics and transport accessibility characteristics. Socioeconomic characteristics included respondents' sex, occupation, monthly household income, and access to a private vehicle. Transport accessibility characteristics included distance to the nearest main road, mode used to reach the main road, frequency of available public transport, difficulty accessing public transport, perceived transport affordability, road condition affecting mobility, and periods when public transport was unavailable.

In the survey, respondents reported their distance to the nearest main road. In the context of this study, the variable is interpreted as proximity to a principal road or transport corridor rather than exclusively to a road administratively classified as a national road. It was included as an indicator of spatial accessibility because residents of dispersed rural settlements may need to reach

principal transport corridors before accessing available public transport. Distance from these roads may therefore represent a first-mile barrier to undertaking essential travel.

Distance to the nearest main road was recorded using four distance categories: less than 500 m, 500 m to 1 km, 1 to 2 km, and more than 2 km. These categories were based on the distance intervals used in the Household Accessibility Survey and were retained in the analysis as categorical measures rather than treated as a continuous distance variable. The thresholds should be interpreted as survey-defined distance bands used to distinguish different levels of proximity to the main road, rather than as empirically derived accessibility thresholds.

These two groups of variables were subsequently used to construct the socioeconomic, transport accessibility, and combined binary logistic regression models described in Section 3.4. The specific categories, coding, and reference categories used for the categorical explanatory variables are presented in Table 1.

Table 1. Definition and Coding of Variables Used in the Binary Logistic Regression Models

Variable	Symbol	Treatment in Model	Categories
Sex	SEX	Categorical factor	Female; Male
Occupation	OCC	Categorical factor	13 occupational categories
Monthly household income	INC	Categorical factor	No income; Low income; Middle income; Higher income
Access to vehicle	VEH	Categorical factor	None; Motorcycle; Tricycle/e-bike; Private car
Distance to nearest main road	DIST	Categorical factor	<500 m; 500 m–1 km; 1–2 km; >2 km
Mode used to reach main road	MODE	Categorical factor	Categories recorded in survey
Frequency of available public transport	FREQ	Categorical factor	Every 15 min; Every 30 min; Every hour; >1 hour
Difficulty accessing public transport	DIFF	Binary categorical	Yes; No
Transport affordability	AFF	Categorical factor	Affordable; Somewhat affordable; Not affordable
Road condition affecting mobility	ROAD	Categorical factor	Muddy/unpaved; Narrow; Flooded; Steep; None
Transport unavailability	UNAV	Categorical factor	Night; Weekend; Bad weather; None

All explanatory variables were entered into the logistic regression according to their measurement structure. The socioeconomic and transport accessibility variables used in the analysis were predominantly categorical and were therefore treated as factors rather than continuous or ordinal numerical scales. For categorical predictors with more than two categories, the model estimated separate parameters for the categories relative to a designated reference category. Thus, numerical codes assigned to categories during data encoding were used only as category identifiers and were not interpreted as equally spaced numerical values. For example, the four distance categories (<500 m, 500 m–1 km, 1–2 km, and >2 km) were entered as categorical

levels rather than as values on a 1–4 continuous scale. The same treatment was applied to other multicategory predictors, including occupation, monthly household income, vehicle access, mode used to reach the main road, public transport frequency, affordability, road condition, and transport unavailability. The estimated odds ratios represent differences in the odds of experiencing at least one failed essential trip for a particular category relative to its designated reference category, holding the other variables in the model constant.

3.4 Statistical Analysis

The study employed both descriptive and inferential statistical techniques. Descriptive statistics were first used to summarize respondents' socioeconomic characteristics, travel behavior, accessibility conditions, and the occurrence of failed essential trips. Frequency distributions and percentages were computed for categorical variables, while appropriate summary statistics were generated for continuous variables.

To identify factors associated with failed essential trips, binary logistic regression was employed. The dependent variable was coded as 1 when a respondent reported experiencing at least one failed essential trip during the previous month and 0 otherwise. The general logistic regression model was expressed as:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ji}$$

where $p_i$represents the probability that respondent $i$experienced at least one failed essential trip; $\beta_0$is the intercept; $\beta_j$represents the regression coefficient associated with explanatory variable j; and X_{ji}represents the value or category of explanatory variable $j$for respondent i.

Three models were estimated to distinguish the contribution of socioeconomic characteristics from that of transport accessibility conditions. Model 1, the Socioeconomic Model, was specified as:

$$\text{logit}(p_i) = \beta_0 + \beta_1 SEX_i + \beta_2 OCC_i + \beta_3 INC_i + \beta_4 VEH_i$$

Model 2, the Transport Accessibility Model, was specified as:

$$\text{logit}(p_i) = \beta_0 + \beta_1 DIST_i + \beta_2 MODE_i + \beta_3 FREQ_i + \beta_4 DIFF_i + \beta_5 AFF_i + \beta_6 ROAD_i + \beta_7 UNAV_i$$

Model 3, the Combined Model, incorporated both groups of explanatory variables and was specified as:

$$\text{logit}(p_i) = \beta_0 + \beta_1 SEX_i + \beta_2 OCC_i + \beta_3 INC_i + \beta_4 VEH_i + \beta_5 DIST_i + \beta_6 MODE_i + \beta_7 FREQ_i + \beta_8 DIFF_i + \beta_9 AFF_i + \beta_{10} ROAD_i + \beta_{11} UNAV_i$$

where SEXdenotes sex; OCC, occupation; INC, monthly household income; VEH, access to a private vehicle; $DIST$, distance to the nearest main road; $MODE$, mode used to reach the main road; $FREQ$, frequency of available public transport; $DIFF$, difficulty accessing public transport; AFF, perceived transport affordability; $ROAD$, road condition affecting mobility; and $UNAV$, periods when public transport was unavailable. Because the explanatory variables were predominantly categorical, they were represented by indicator variables relative to specified reference categories, as detailed in Table 2.

Because the explanatory variables were entered as categorical factors, each predictor with $k$categories was represented in the regression by $k-1$ parameters relative to its designated reference category. The reported coefficients and odds ratios for individual categories therefore

represent comparisons with the corresponding reference category and should not be interpreted as effects of a one-unit increase in an underlying numerical scale.

Table 2. Variables Included in the Binary Logistic Regression Models

Variable Group	Explanatory Variable	Symbol	Model 1: Socioeconomic	Model 2: Transport Accessibility	Model 3: Combined
Socioeconomic Characteristics	Sex	SEX	✓	—	✓
	Occupation	OCC	✓	—	✓
	Monthly household income	INC	✓	—	✓
	Access to vehicle	VEH	✓	—	✓
Transport Accessibility Characteristics	Distance to nearest main road	DIST	—	✓	✓
	Mode used to reach main road	MODE	—	✓	✓
	Frequency of available public transport	FREQ	—	✓	✓
	Difficulty accessing public transport	DIFF	—	✓	✓
	Transport affordability	AFF	—	✓	✓
	Road condition affecting mobility	ROAD	—	✓	✓
	Transport unavailability	UNAV	—	✓	✓

Model parameters were estimated using the Maximum Likelihood Estimation (MLE) method. The estimated regression coefficients were exponentiated to obtain Odds Ratios (ORs), facilitating the interpretation of the effect of each explanatory variable on the likelihood of experiencing a failed essential trip. The statistical significance of individual predictors was evaluated using the Wald test at the 5% significance level, while the overall contribution of each predictor was assessed using the Omnibus Likelihood Ratio Test. Prior to model estimation, multicollinearity among explanatory variables was examined using the Variance Inflation Factor (VIF). The predictive performance of the final model was evaluated using Nagelkerke's pseudo-R^2, overall classification accuracy, sensitivity, specificity, and the Area Under the Receiver Operating Characteristic Curve (AUC). These diagnostic measures were used to assess the

explanatory capability, classification performance, and discriminatory ability of the fitted binomial logistic regression model.

4. RESULTS AND DISCUSSION

This chapter presents the results of the descriptive and inferential analyses conducted to identify the determinants of failed essential trips in the Municipality of Sibuco. The presentation begins with respondents' socioeconomic and transport accessibility characteristics, followed by the incidence of failed essential trips, the results of the binomial logistic regression analysis, the interpretation of significant predictors, model performance, and the implications of the findings for rural public transport planning.

4.1. Respondents' Profile

A total of 329 respondents were included in the analysis. Table 3 presents the socioeconomic and transport accessibility characteristics of the respondents. Female respondents comprised the majority of the sample (59.0%), while males accounted for 41.0%. The income profile indicates that most households belonged to the low-income category (56.8%), followed by respondents with no reported income (38.0%), reflecting the predominantly low-income and rural socioeconomic conditions of the municipality.

More than half of the respondents (51.7%) reported not owning any private vehicle, while 38.9% owned motorcycles. Only a small proportion owned private cars (4.6%) or tricycles/e-bikes (4.9%), indicating that a large segment of the population relies on public or shared transport for their daily travel needs. These findings indicate that more than half of the surveyed respondents had no access to a private vehicle, highlighting the importance of available public and shared transport options for meeting their mobility needs.

In terms of spatial accessibility, 44.1% of respondents lived within 500 m of the nearest main road, while 21.3% lived between 500 m and 1 km, 15.2% between 1 and 2 km, and 19.5% more than 2 km away. Thus, while the largest group of respondents lived relatively close to a main road, 34.7% lived more than 1 km away. This distribution indicates substantial variation in respondents' proximity to the principal road or transport corridor through which public transport may be accessed. Such variation is relevant to the analysis because distance to the nearest main road represents a potential first-mile accessibility constraint and was subsequently examined as a predictor of failed essential trips.

Transport affordability was generally viewed positively, with 71.7% of respondents indicating that transport was affordable. Nevertheless, environmental conditions remained an important concern. The most frequently reported road condition affecting mobility was flooding (40.1%), followed by muddy or unpaved roads (21.0%). Furthermore, 50.8% of respondents identified bad weather as the period during which transport services were most likely to become unavailable, compared with 28.3% who cited nighttime and 16.4% who reported weekends. These descriptive findings suggest that while transport services are generally present within the municipality, their accessibility and reliability are considerably affected by road conditions and weather-related disruptions, potentially contributing to transport-related mobility exclusion.

Table 3. Socioeconomic and Transport Accessibility Characteristics of Respondents (N = 329)

Characteristic	Category	Frequency (n)	Percentage (%)
Sex	Female	194	59.0
	Male	135	41.0
Monthly Household Income	No income	125	38.0
	Low income	187	56.8
	Middle income	15	4.6
	Higher income	2	0.6
Access to Vehicle	None	170	51.7
	Motorcycle	128	38.9
	Tricycle/e-bike	16	4.9
	Private car	15	4.6
Distance to the Nearest Main Road	<500 m	145	44.1
	500 m–1 km	70	21.3
	1–2 km	50	15.2
	>2 km	64	19.5
Frequency of Available Public Transport	Every 15 minutes	157	47.7
	Every 30 minutes	96	29.2
	Every hour	65	19.8
	More than one hour	11	3.3
Difficulty Accessing Public Transport	Yes	218	66.3
	No	111	33.7
Transport Affordability	Affordable	236	71.7
	Not affordable	54	16.4
	Somewhat affordable	39	11.9
Road Condition Affecting Mobility	Muddy/Unpaved	69	21.0
	Narrow roads	23	7.0
	Flooded areas	132	40.1
	Steep roads	13	4.0
	None	92	28.0
Periods When Transport is Unavailable	Night	93	28.3
	Weekend	54	16.4
	Bad weather	167	50.8
	None	15	4.6

4.2. Incidence of Failed Essential Trips

Table 4 presents the distribution of respondents according to the occurrence of failed essential trips during the month preceding the survey. Of the 329 respondents, 178 (54.1%) reported experiencing at least one failed essential trip, while 151 respondents (45.9%) reported that they had successfully completed all of their essential trips.

Table 4. Distribution of Respondents According to Failed Essential Trips

Failed Essential Trip	Frequency (n)	Percentage (%)
No failed essential trip	151	45.9
Experienced one or more failed essential trips	178	54.1
Total	329	100.0

The relatively high proportion of respondents reporting failed essential trips suggests that transport-related mobility exclusion is a significant concern within the Municipality of Sibuco. More than half of the surveyed residents experienced situations in which transport-related constraints prevented them from reaching important destinations such as workplaces, schools, healthcare facilities, government offices, markets, or other essential services. These findings indicate that transport barriers in rural communities extend beyond increased travel time or inconvenience and can directly limit participation in essential daily activities.

Unlike conventional transport indicators that primarily evaluate mobility in terms of travel speed, travel time, or infrastructure provision, failed essential trips capture the actual consequences of inadequate transport accessibility on individuals' lives. A failed trip represents an unmet travel need arising from limitations in transport availability, service reliability, physical accessibility, affordability, or adverse environmental conditions. Thus, the indicator provides a direct measure of transport-related mobility exclusion by identifying individuals who are unable to access essential opportunities because of transport system deficiencies.

The high incidence of failed essential trips observed in this study further justifies the application of binary logistic regression to identify the transport-related and socioeconomic factors associated with this outcome. Understanding which accessibility barriers significantly increase the likelihood of experiencing a failed essential trip is essential for developing targeted interventions that improve equitable access to essential services and support evidence-based public transport planning in rural municipalities.

4.3. Binary Logistic Regression Analysis

To identify the factors associated with failed essential trips, three binomial logistic regression models were estimated. The first model included respondents' socioeconomic characteristics, the second considered transport accessibility characteristics, while the third integrated both socioeconomic and transport accessibility variables. This hierarchical modelling approach enabled the incremental contribution of transport accessibility variables to be evaluated after accounting for respondents' socioeconomic characteristics.

Table 5. Comparison of Binary Logistic Regression Models

Model	Variables Included	Deviance	McFadden's R^2	Cox & Snell R^2	Nagelkerke R^2
Model 1	Socioeconomic Characteristics	413	0.089	0.118	0.155
Model 2	Transport Accessibility Characteristics	362	0.203	0.244	0.326
Model 3	Combined Model	340	0.251	0.293	0.391

Table 5 presents the goodness-of-fit statistics for the three estimated models. Among the three models, the combined model demonstrated the best overall performance, yielding the lowest deviance value (340) and the highest pseudo-R^2 values, with McFadden's pseudo-R^2 of 0.251, Cox and Snell's pseudo-R^2 of 0.293, and Nagelkerke's pseudo-R^2 of 0.391. Compared with the socioeconomic model, which explained only 15.5% of the variation in failed essential trips, the inclusion of transport accessibility variables substantially improved model performance. Transport accessibility variables alone explained 32.6% of the variation, while the combined model explained 39.1%, demonstrating that transport accessibility contributes more substantially to mobility exclusion than socioeconomic characteristics.

To determine the contribution of each explanatory variable, omnibus likelihood ratio tests were performed. As shown in Table 6, frequency of available public transport ($\chi^2 = 12.590, p = 0.006$), difficulty accessing public transport ($\chi^2 = 19.858, p < 0.001$), and road condition ($\chi^2 = 13.752, p = 0.008$) significantly improved the explanatory capability of the model. Distance to the nearest main road exhibited a marginal association with failed essential trips ($\chi^2 = 7.678, p = 0.053$). In contrast, respondents' sex, occupation, monthly household income, access to private vehicles, transport affordability, transport unavailability, and mode used to reach the main road did not significantly contribute to explaining the occurrence of failed essential trips after controlling for the remaining variables.

Table 6. Omnibus Likelihood Ratio Tests for the Final Binomial Logistic Regression Model

Predictor	**χ^2**	**df**	**p-value**
Sex	0.889	1	0.346
Occupation	16.176	12	0.183
Monthly Income	5.175	3	0.159
Access to Vehicle	3.405	3	0.333
Distance to Nearest Main Road	7.678	3	0.053
Mode Used to Reach Main Road	3.094	4	0.542
Frequency of Available Public Transport	**12.590**	**3**	**0.006**
Difficulty Accessing Public Transport	**19.858**	**1**	**<0.001**
Transport Affordability	1.359	2	0.507
Road Condition	**13.752**	**4**	**0.008**
Transport Unavailability	4.469	3	0.215

These findings indicate that transport accessibility variables exert a considerably stronger influence on transport-related mobility exclusion than respondents' socioeconomic characteristics.

4.4. Interpretation of Significant Predictors

The final binary logistic regression model identified four transport accessibility variables that significantly influenced the likelihood of experiencing a failed essential trip. These variables included distance to the nearest main road, frequency of available public transport, difficulty accessing public transport, and road conditions affecting mobility. Notably, none of the socioeconomic characteristics remained statistically significant after controlling for transport accessibility variables, indicating that transport system conditions exert a stronger influence on mobility exclusion than individual socioeconomic attributes. Table 7 summarizes the statistically significant predictors retained in the final binary logistic regression model.

Table 7. Significant Predictors of Failed Essential Trips from the Final Binary Logistic Regression Model

Predictor	β	SE	Odds Ratio	95% Confidence Interval	p-value
Distance to nearest main road (<500 m vs. 500 m–1 km)	-0.866	0.418	0.421	0.186–0.954	0.038
Frequency of available public transport (Every hour vs. Every 15 minutes)	1.255	0.469	3.507	1.399–8.788	0.007
Difficulty accessing public transport (No vs. Yes)	-1.387	0.323	0.250	0.133–0.471	<0.001
Road condition (None vs. Muddy/Unpaved)	-0.890	0.451	0.411	0.170–0.993	0.048

Because the accessibility predictors were modeled as categorical factors, statistical significance at the predictor level and significance of individual category contrasts were distinguished in interpreting the results. The Omnibus Likelihood Ratio Test assessed whether a categorical predictor as a whole contributed significantly to the model, whereas the reported coefficients and odds ratios represent specific category comparisons relative to the designated reference category. Thus, categories such as muddy/unpaved, narrow, flooded, steep, and no reported road-condition problem were treated as qualitatively distinct conditions rather than as increasing levels on a numerical road-condition scale.

4.4.1 Distance to the Nearest Main Road

Distance from the nearest main road was found to be a significant predictor of failed essential trips. Respondents residing within 500 meters of the nearest main road had significantly lower odds of experiencing a failed essential trip than those residing 500 meters to 1 kilometer away (OR = 0.421, p = 0.038). Specifically, living within 500 meters reduced the odds of experiencing a failed essential trip by approximately 57.9% relative to respondents located farther from the main transport corridor.

This finding aligns with the broader first-mile/last-mile (FLM) literature, which consistently identifies the walk to and from a transport stop as a critical determinant of whether a trip is attempted or completed at all. Research on FLM access has shown that the probability of a trip failing to materialize rises sharply once walking distances exceed a relatively short threshold, since the physical and time burden of reaching a stop competes directly with the perceived benefit of the trip itself (Lu et al., 2024). Comparable evidence from Stockholm County demonstrates that access to public transport within walking distance deteriorates markedly for low-density, semi-rural settlements compared to urban cores, a pattern attributed to the fact that planning guidelines for transit catchments are typically calibrated for compact, urban-density populations rather than dispersed rural ones (Kåresdotter et al., 2022). Similarly, FLM-focused studies in developing-country contexts report that commuters facing longer first- and last-mile distances disproportionately experience accessibility difficulty, and that the resulting challenges of cost, exposure to weather, and personal safety act as compounding barriers rather than a single isolated inconvenience (Sogbe et al., 2024). These parallels suggest that the Sibuco finding is not a

localized anomaly but a documented feature of transport systems wherever feeder connections to the main network are weak.

This finding highlights the importance of first-mile accessibility in rural transport systems. In municipalities such as Sibuco, residents commonly walk from their homes to the nearest road where public transport services are available. Even relatively short increases in walking distance may discourage travel, particularly among older adults, persons with disabilities, and individuals carrying goods or travelling during adverse weather conditions. Consistent with findings from rural Sweden, where elderly and mobility-impaired residents were shown to have substantially reduced catchment access compared to the general population (Kåresdotter et al., 2022), this suggests that the burden of first-mile distance in Sibuco is likely unevenly distributed across the population rather than uniformly experienced. Thus, households located farther from the transport network are more vulnerable to mobility exclusion because reaching available transport services already represents a substantial travel burden before the actual trip begins.

From a transport planning perspective, the finding suggests that improving feeder connections between dispersed settlements and the primary transport network may substantially reduce failed essential trips. This is consistent with recommendations from rural mobility studies in Sweden, which propose linking dispersed rural areas to public transport hubs through coordinated feeder services rather than relying solely on extending fixed-route coverage (Berg & Ihlström, 2019). Infrastructure improvements such as farm-to-market roads, pedestrian pathways, or community feeder transport services could shorten first-mile travel distances and improve access to essential destinations.

4.4.2 Frequency of Available Public Transport

Public transport frequency emerged as another significant determinant of failed essential trips. Respondents whose communities were served by public transport every hour were approximately 3.5 times more likely to experience a failed essential trip than respondents served every 15 minutes (OR = 3.507, p = 0.007).

This result is consistent with the established literature distinguishing service coverage from service quality. Currie and Delbosc's foundational work on transport disadvantage argues that the mere presence of a route is an insufficient measure of accessibility, and that headway, or the time interval between vehicles, is what ultimately governs whether transport is usable for time-sensitive activities (Delbosc & Currie, 2011). This distinction has since been formalized in transit-availability indices that weight proximity to a stop by service frequency, rather than treating any stop within a buffer distance as equally accessible (Sun & Thakuriah, 2021). The relationship between frequency and reliable access is further reflected in ridership-elasticity studies, which find that shorter headways are associated with disproportionately higher and more dependable use of transit services, reinforcing that infrequent service does not just inconvenience riders but measurably reduces successful trip completion (Berrebi et al., 2021).

This result demonstrates that transport availability should not be assessed solely by the existence of transport services but also by the frequency with which those services operate. Although transport may technically be available within a community, long service intervals reduce travel flexibility, increase waiting times, and increase the likelihood that individuals will miss work, medical appointments, school, or other essential activities. This mirrors findings from studies of rural and regional transport disadvantage in Australia, where infrequent and unreliable services were identified as a primary mechanism excluding residents from employment,

healthcare, and social participation, independent of whether a route nominally served their area (Busco et al., 2025). Rural transport systems frequently operate with limited vehicle fleets and irregular schedules, making infrequent services one of the principal mechanisms through which transport disadvantage occurs.

The result suggests that increasing service frequency along key corridors may contribute more substantially to reducing mobility exclusion than simply expanding transport coverage. This is consistent with evidence that increases in service frequency are associated with measurably larger effective catchment areas for transit stops, suggesting that frequency improvements can extend practical accessibility even without physical route expansion (van Kuijk et al., 2022). Improving vehicle dispatch schedules and increasing the number of operating units during periods of high travel demand may significantly decrease the occurrence of failed essential trips.

4.4.3 Difficulty Accessing Public Transport

Among all variables included in the model, difficulty accessing public transport exhibited the strongest statistical association with failed essential trips. Respondents who did not experience difficulty accessing public transport had approximately 75.0% lower odds of experiencing a failed essential trip than respondents who reported accessibility difficulties (OR = 0.250, $p < 0.001$).

This finding emphasizes that mobility exclusion extends beyond the availability of transport services. Accessibility difficulties may arise from long walking distances, limited vehicle availability, poor road conditions, inadequate waiting facilities, or other operational barriers that collectively prevent individuals from successfully reaching public transport. This composite framing of accessibility is well established in the transport equity literature: Dodson and colleagues argue that transport systems can either compound or alleviate existing disadvantage depending on how multiple barriers interact, and that vulnerable groups are disproportionately exposed to the cumulative effect of these barriers rather than any single one in isolation (Nogueira & Diaz, 2023). Walkability assessments in Metro Manila similarly found that the absence of basic pedestrian infrastructure, such as accessible walking paths, rain shelters, and disability-supportive design, substantially constrained residents' ability to reach transit stops even where routes existed nearby (Nogueira & Diaz, 2023). Thus, simply increasing the number of vehicles may not eliminate mobility exclusion if these underlying accessibility constraints remain unresolved.

The result reinforces the concept that transport accessibility represents the combined interaction of infrastructure, service provision, and user experience. Recent work on integrated mobility services in regional and rural areas similarly frames accessibility as the product of physical infrastructure, geographic isolation, and service design operating together, rather than as a function of any one factor, and explicitly links unresolved access barriers to reduced healthcare utilization among low-income populations (Jahangir et al., 2024). Addressing these interconnected barriers is therefore essential for improving equitable access to employment, education, healthcare, markets, and government services.

4.4.4 Road Conditions Affecting Mobility

Road conditions also significantly influenced the likelihood of experiencing failed essential trips. Respondents who reported no road condition problems had approximately 58.9% lower odds of experiencing a failed essential trip than respondents travelling on muddy or unpaved roads (OR = 0.411, $p = 0.048$).

Poor road conditions represent one of the most persistent transport barriers in rural municipalities. Muddy or unpaved roads often become impassable during periods of heavy rainfall, limiting both residents' ability to reach transport services and operators' willingness to serve affected communities. This pattern has been well documented elsewhere in Mindanao: a World Bank assessment of rural connectivity in the region found that gravel roads linking remote barangays to major highways frequently become impassable to motorcycle and tricycle traffic during the rainy season, directly disrupting residents' transport access (World Bank, 2024). National-level data likewise indicate that a meaningful share of the Philippine local road network remains unpaved or in poor condition, with Mindanao recording lower road density than the national average, a structural disadvantage that compounds the seasonal impassability problem (PIDS, 2023). GIS-based assessments of rural municipal road networks elsewhere in the country have similarly identified substantial proportions of barangay roads in poor condition requiring rehabilitation, reinforcing that the road-quality barrier observed in Sibuco reflects a wider national pattern rather than a localized deficiency (Fruelda et al., 2025). These conditions contribute to service unreliability, longer travel times, and complete transport interruptions during adverse weather conditions.

For municipalities such as Sibuco, the findings highlight that transport planning should not focus exclusively on route development or fleet expansion. Road improvement initiatives, particularly along feeder roads connecting remote barangays to the primary transport network, are equally important in ensuring that public transport services remain accessible throughout the year. This conclusion is consistent with regional transport connectivity planning in Mindanao, which explicitly pairs primary corridor investment with complementary local road upgrades under rural development programs, on the basis that corridor-level improvements alone do not resolve last-mile impassability for outlying communities (World Bank, 2024). Integrating road infrastructure improvements with public transport planning would therefore contribute to reducing transport-related mobility exclusion and improving access to essential opportunities.

4.5. Model Performance

The predictive performance of the final binomial logistic regression model was evaluated using measures of model fit, classification performance, and discriminatory ability, as shown in Table 8. The omnibus likelihood ratio test indicated that the overall model was statistically significant ($\chi^2 = 114$, $p < 0.001$), demonstrating that the fitted model provided a significantly better explanation of failed essential trips than the intercept-only model.

The classification results further demonstrated satisfactory predictive performance. Using a probability cut-off value of 0.50, the model correctly classified 242 of the 329 respondents, corresponding to an overall classification accuracy of 73.6%. The model achieved a sensitivity of 74.7%, indicating that it correctly identified nearly three-fourths of respondents who experienced failed essential trips. Similarly, the specificity of 72.2% indicates that the model accurately classified respondents who did not experience failed essential trips. These results suggest that the model performs consistently in distinguishing between respondents who experienced mobility exclusion and those who did not.

The receiver operating characteristic (ROC) analysis further confirmed the predictive capability of the model. The estimated area under the curve (AUC) was 0.819, indicating good discriminatory performance. An AUC value exceeding 0.80 suggests that the model possesses a

high probability of correctly distinguishing respondents who experienced failed essential trips from those who did not.

Overall, the combination of statistically significant model fit, satisfactory classification accuracy, balanced sensitivity and specificity, and good discriminatory performance demonstrates that the final binomial logistic regression model provides a reliable representation of the transport-related factors associated with failed essential trips.

Table 8. Performance Measures of the Final Binomial Logistic Regression Model

Performance Measure	**Value**
Overall Model χ^2	114
p-value	<0.001
Deviance	340
McFadden's (R^2)	0.251
Cox & Snell (R^2)	0.293
Nagelkerke (R^2)	0.391
Overall Classification Accuracy	73.6%
Sensitivity	74.7%
Specificity	72.2%
Area Under the ROC Curve (AUC)	0.819

4.6. Implications for Rural Transport Planning

The findings of this study demonstrate that transport-related mobility exclusion in the Municipality of Sibuco is influenced primarily by transport accessibility conditions rather than respondents' socioeconomic characteristics. While household characteristics such as sex, income, occupation, and vehicle ownership were not statistically significant predictors of failed essential trips, factors associated with physical accessibility and transport service provision were found to substantially influence the likelihood of mobility exclusion. This suggests that improving transport accessibility should be the primary focus of rural transport planning interventions.

The significance of distance to the nearest main road underscores the importance of first-mile accessibility in rural communities. Residents located farther from the primary transport network face additional physical barriers before they can even access available transport services. Thus, future transport planning should prioritize the development of feeder roads, pedestrian access facilities, and community-based feeder transport services that improve connectivity between dispersed settlements and the main transport corridors.

Similarly, the significance of public transport service frequency indicates that the availability of transport alone is insufficient to ensure accessibility. Communities served by infrequent public transport remain vulnerable to failed essential trips because limited service intervals reduce travel flexibility and increase the likelihood of missing essential activities. Increasing service frequency, particularly along routes connecting remote barangays to the municipal center, should therefore be considered a priority intervention.

The results also demonstrate that difficulty accessing public transport is the strongest determinant of failed essential trips. This finding suggests that accessibility barriers arise not only from transport supply but also from the interaction between infrastructure, service operations, and users' ability to reach available services. Addressing these barriers requires an integrated approach involving improved boarding locations, enhanced feeder connectivity, better passenger facilities,

and coordinated transport services that collectively reduce the effort required to access public transport.

Finally, the significance of road conditions emphasizes the importance of integrating transport planning with road infrastructure development. Poor road conditions, particularly muddy or unpaved roads, reduce transport reliability and may discourage operators from serving remote communities during adverse weather conditions. Improving the condition of barangay roads and maintaining all-weather accessibility would therefore enhance both transport operations and residents' access to essential opportunities.

4.6.1 Failed Essential Trips as a Complementary Planning Indicator

Conventional Local Public Transport Route Plans (LPTRPs) primarily use origin–destination (OD) surveys, passenger counts, and observed travel demand to characterize existing travel patterns and inform route and service planning. These approaches are effective for examining trips that actually occur but may not fully capture travel needs that remain unrealized because transport-related barriers prevent individuals from undertaking intended trips. Failed essential trips (FET) provide a complementary perspective by identifying instances in which essential travel needs exist but the corresponding trips do not materialize.

The principal contribution of FET assessment to the LPTRP process is therefore not simply the identification of communities located far from existing routes or transport corridors, since spatial accessibility and route coverage are already considered in conventional public transport planning. Rather, its added value lies in identifying travel needs that may not appear in observed trip records because the intended trips were not successfully undertaken. Conventional OD surveys and passenger counts primarily capture realized travel demand, whereas FET provides evidence of a suppressed or unmet component of travel demand. Table 9 summarizes these complementary roles.

Table 9. Complementary Roles of Conventional LPTRP Indicators and Failed Essential Trips

Conventional LPTRP Indicators	Failed Essential Trips
Capture trips that are actually undertaken	Capture intended essential trips that were not successfully undertaken
Measure realized or observed travel demand	Provide evidence of suppressed or unmet travel demand
Describe existing origins, destinations, and passenger movements	Identify unmet essential travel needs associated with transport constraints
Support route and service analysis based on observed travel	Complement observed demand by identifying mobility needs that may not appear in trip records
Provide evidence on existing passenger demand and travel patterns	Provide additional evidence on transport-related mobility exclusion

In practical LPTRP applications, FET assessment can be incorporated into the household accessibility component of the same data collection process, rather than requiring a separate planning exercise. Conventional OD and passenger surveys can first be used to characterize existing travel patterns, major origins and destinations, and observed passenger demand. Household accessibility data can then be used to identify the incidence of FET and the locations and transport conditions associated with respondents experiencing these failures. The two sources of information can subsequently be examined together to identify areas where relatively low

observed travel demand coexists with accessibility constraints and reported failed essential travel. Such areas may warrant further assessment because low observed ridership may partly reflect an inability to undertake desired essential travel rather than an absence of travel need.

For the Sibuco LPTRP, FET can therefore function as a complementary screening indicator rather than a stand-alone basis for route development or investment prioritization. Areas exhibiting both FET and substantial accessibility constraints may be flagged by the LGU and relevant transport-planning agencies for closer assessment. FET information can then be considered alongside OD patterns, observed and potential passenger demand, existing route coverage, service conditions, technical feasibility, operating conditions, costs, and service viability when determining appropriate interventions. Depending on the nature of the accessibility constraint, potential responses may include route or service-frequency adjustments, feeder connectivity, road-access improvements, service coordination, or other accessibility measures. Importantly, a high incidence of FET does not automatically imply that a new route or additional public transport units should be introduced, particularly where additional services may not be operationally or financially viable.

Conceptually, potential essential-travel demand may be viewed as comprising both observed or realized travel demand and suppressed essential-trip demand:

$$D_{\text{potential}} = D_{\text{observed}} + D_{\text{suppressed}}$$

where $D_{\text{potential}}$represents potential essential-travel demand, D_{observed}represents trips captured through conventional OD or passenger-demand surveys, and $D_{\text{suppressed}}$represents intended essential trips that did not materialize because of transport-related constraints. This formulation is presented as a conceptual framework for integrating unmet travel needs into demand assessment, rather than as an empirical demand estimate produced by the present model.

The logistic regression model used in this study serves an explanatory rather than demand-forecasting function. Although the Household Accessibility Survey elicited the reported number of failed essential trips during the preceding month, the present analysis transformed this information into a binary respondent-level indicator of whether at least one FET occurred. Consequently, the model identifies the incidence of FET and the accessibility conditions associated with its occurrence but does not estimate the total volume of suppressed trips or the number of additional passenger trips that would occur if the identified constraints were removed. The FET incidence estimated in this study should therefore not be directly added to observed passenger demand.

Future LPTRP applications can extend this approach by retaining trip-level information on the number of failed essential trips, trip purpose, intended origin and destination, reason for failure, and whether the intended trip was subsequently completed. These data could be aggregated geographically, by travel purpose, and by intended OD pair to estimate the magnitude and spatial distribution of suppressed essential-trip demand. This suppressed component could then be considered alongside conventionally observed demand when assessing potential route and service requirements. However, suppressed demand should not automatically be treated as equivalent to immediately realizable passenger demand, since whether an intended trip becomes an actual public transport trip would depend on the removal of the relevant accessibility constraint and the operational and financial feasibility of the proposed service.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study examined the transport-related factors associated with failed essential trips in the Municipality of Sibuco, Zamboanga del Norte, using binary logistic regression analysis. Failed essential trips were used as an indicator of transport-related mobility exclusion, representing instances in which individuals were unable to undertake essential travel because of transport-related constraints. By integrating household accessibility data collected during the preparation of the Local Public Transport Route Plan (LPTRP), the study provides empirical evidence on accessibility barriers affecting the surveyed population.

The findings indicate that failed essential travel is a substantial mobility concern among the surveyed respondents, with more than half reporting at least one failed essential trip during the month preceding the survey. This suggests that transport barriers in Sibuco extend beyond inconvenience or increased travel time and may prevent residents from undertaking travel needed to access employment, education, healthcare, markets, government services, and other essential opportunities.

The regression results indicate that transport accessibility characteristics provided greater explanatory contribution than the socioeconomic characteristics included in the models. Public transport frequency, difficulty accessing public transport, and road conditions were significant at the predictor level, while a specific contrast within distance to the nearest main road was also statistically significant. In comparison, sex, occupation, household income, and vehicle access were not statistically significant in the combined model. These findings highlight the importance of spatial access, service availability, and supporting road infrastructure in understanding the occurrence of failed essential trips within the surveyed population.

The final combined model demonstrated satisfactory explanatory and discriminatory performance, indicating that the variables included in the analysis provide meaningful information for distinguishing respondents who experienced failed essential trips from those who did not. Nevertheless, the findings should not be interpreted as implying that accessibility gaps can be addressed solely by increasing public transport supply. In a rural setting such as Sibuco, additional or more frequent services must also be considered in relation to passenger demand and the financial and operational viability of transport provision. Appropriate responses may therefore include not only route or service adjustments but also feeder connectivity, road-access improvements, service coordination, or other measures addressing the specific accessibility constraint identified.

From a planning perspective, the principal contribution of the FET approach lies in its ability to reveal a dimension of travel demand that may remain unobserved in conventional transport surveys. Origin–destination surveys and passenger counts primarily capture trips that actually occur, whereas failed essential trips provide evidence of travel needs that remain unrealized because of transport-related constraints. FET can therefore provide complementary evidence for local government units and other agencies involved in local public transport planning by helping identify potentially underserved areas where observed travel demand alone may not fully reflect mobility needs.

FET should not, however, be used as a stand-alone basis for route development or investment prioritization. Rather, information on FET incidence and associated accessibility constraints should be considered alongside conventional LPTRP indicators, including observed passenger demand, origin–destination patterns, existing route coverage, service conditions,

technical feasibility, costs, and service viability. Areas exhibiting both failed essential travel and substantial accessibility constraints may consequently be flagged for further assessment to determine whether route or service adjustments, feeder connections, road improvements, or other interventions are warranted.

Finally, the present binary FET measure identifies the incidence of unmet essential travel needs at the respondent level, but does not estimate the total volume of suppressed or unserved trips. Future LPTRP applications can extend the approach by retaining information on the number, purpose, origin, intended destination, and reasons for failed trips. Such information would allow suppressed essential-trip demand to be quantified and considered alongside observed demand in route and service planning. FET should therefore be viewed as a complementary demand and accessibility indicator rather than a replacement for conventional LPTRP demand analysis.

5.2 Recommendations

The findings of this study demonstrate that transport-related mobility exclusion in the Municipality of Sibuco is primarily influenced by transport accessibility conditions rather than socioeconomic characteristics. Based on the significant predictors identified in the binary logistic regression analysis, the following recommendations are proposed.

5.2.1 Recommendations for the Municipality of Sibuco and the Local Public Transport Route Plan (LPTRP)

The municipality should prioritize accessibility-oriented transport planning by focusing on improving the availability, reliability, and physical accessibility of public transport services. Future updates of the Local Public Transport Route Plan should incorporate accessibility indicators, such as failed essential trips, in addition to conventional travel demand measures to identify underserved communities and prioritize transport interventions.

Areas with high incidences of failed essential trips should be considered priority locations for transport service improvements, particularly those located farther from the primary transport network. Expanding feeder services connecting remote barangays to the municipal center and major transport corridors would improve first-mile accessibility and reduce the likelihood of residents being unable to reach essential destinations.

5.2.2 Recommendations for Public Transport Operations

Since public transport frequency was identified as a significant determinant of failed essential trips, transport operators should improve service frequency along existing routes, particularly during periods of high travel demand. Long service intervals reduce travel flexibility and increase the risk of missed employment opportunities, healthcare appointments, educational activities, and other essential trips.

The municipality should likewise monitor route performance and coordinate with transport operators to ensure that adequate transport services remain available throughout the day, including periods when residents frequently experience transport shortages.

5.2.3 Recommendations for Road and Accessibility Improvements

Road infrastructure improvements should complement public transport planning. The significance of road conditions and proximity to the main road demonstrates that accessibility problems begin before individuals board public transport. Accordingly, the municipality should prioritize the improvement of feeder roads serving geographically isolated barangays, particularly those that become muddy or impassable during periods of heavy rainfall.

Where road improvements cannot immediately be undertaken, alternative community-based transport solutions, such as scheduled feeder services or demand-responsive transport, may provide interim accessibility improvements for isolated communities.

5.2.4 Recommendations for Future Research

Future studies should extend the analysis by incorporating spatial accessibility measures using Geographic Information Systems (GIS) and transport network analysis to examine how geographic location influences failed essential trips. Integrating objective measures of accessibility with household survey data would provide a more comprehensive understanding of transport-related mobility exclusion.

Future applications of the FET indicator should extend the binary measure used in this study by recording the number of failed travel attempts within a defined recall period, together with the purpose, intended origin and destination, and transport-related reason for each unsuccessful trip. Where an essential trip is eventually completed after one or more unsuccessful attempts, recording the number of attempts required before successful completion would provide additional information on the severity and persistence of transport-related mobility exclusion. Such information would also enable future studies to estimate the volume of suppressed or unserved trips rather than only the proportion of individuals experiencing them.

Longitudinal studies are also recommended to examine how changes in transport infrastructure, service provision, and LPTRP implementation influence the occurrence of failed essential trips over time. Such studies would enable the evaluation of transport interventions and provide stronger evidence regarding the long-term effectiveness of accessibility improvements.
Finally, future research should validate the failed essential trip indicator in other rural municipalities and urban settings to determine its applicability across different geographic and transport contexts. Comparative studies would contribute to the development of a more robust framework for measuring transport-related mobility exclusion and support the formulation of accessibility-oriented transport policies at both local and national levels.

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