UNDERSTANDING MODE CHOICE PATTERNS FOR SUSTAINABLE PUBLIC TRANSPORT IN NAMIBIA: IS "FORMAL" PUBLIC TRANSPORT A VIABLE OPTION?

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ABSTRACT

This study examines mode choice patterns along the MR92 corridor in northern Namibia to evaluate the potential demand for formal public transport and to understand the factors inhibiting its uptake, including the influence of cost and travel time on commuters' choices. A mixed-methods approach was adopted, combining stated preference (SP) surveys, origin-destination (O-D) surveys, and interviews. The SP survey quantified the proportion of users for whom formal public transport (e.g. buses or shuttles) is a viable alternative to the current informal taxis. The O-D survey captured actual travel patterns and distances, and interviews provided qualitative insights into commuters' preferences and concerns. The results show that only about 46.2 % of current public transport users would be willing to shift to "formal" public transport under the given conditions, reflecting significant barriers to adoption. Key factors such as travel cost, accessibility, convenience, comfort, hygiene, personal attitudes, socio-demographics, travel behaviour, and climatic conditions significantly influence mode choice decisions. Although informal taxis remain the preferred mode for most (due to their high frequency and convenience), the findings suggest that with targeted improvements, such as reduced travel times, increased service frequency, and competitive fares, there is an opportunity to encourage a mode shift. The study recommends planning interventions and service improvements to enhance the viability of formal public transport in the Namibian context, while acknowledging practical challenges like financial sustainability and commuter trade-offs between cost, convenience, and safety.

Keywords: Public transport, Mode choice, Mode shift, Surveys, Namibia.

1. INTRODUCTION

The transportation sector is a major contributor to carbon emissions globally (responsible for roughly between 20 and 25% of CO_2 emissions), making the transition to sustainable mobility a pressing priority (Albuquerque *et al.*, 2020). In Sub-Saharan Africa (SSA), public transport systems face unique challenges, including fragmented services and a heavy reliance on informal modes (Kamundu, 2019; Jones *et al.*, 2022). Northern Namibia, specifically the Oshana Region, exemplifies these challenges. The region currently depends overwhelmingly on paratransit systems (informal shared taxis) to meet mobility needs (GIZ, 2021). These informal services fill a critical mobility gap but often lack the efficiency, reliability, and safety required for long-term sustainability (Ambunda & Nakale, 2020; Jones *et al.*, 2022; Nyamai *et al.*, 2024). As a result, Namibia's public transport sector has been scrutinised for being unreliable and unsafe, with informal services accounting for 90 % of public transport usage (Ambunda & Nakale, 2020).

This overreliance on informal public transport services has raised concerns about financial sustainability and equitable access. The Oshana Region, with its urban centres Ondangwa, Ongwediva, and Oshakati, is a hub of informal public transport, where over 50% of residents rely on shared taxis for mobility (GIZ, 2021). Central to these towns is the C46 road (now designated MR92), a vital corridor for economic and social activity. However, this corridor currently lacks a formal, scheduled public transport service. The absence of formal buses or similar services means commuters must choose between driving private cars (for those who have them) or using the ubiquitous shared taxis (Starkey *et al.*, 2017). This situation poses a question: Is there demand for a formal public transport option on the MR92, and what would it take for commuters to switch to it? Against this backdrop, this study aims to investigate the potential for formal public transport along the MR92 corridor. In particular, the study seeks to:

- Determine the demand for a formal public transport service among current commuters on the MR92 corridor;
- Identify the socio-economic and behavioural factors that inhibit or encourage the uptake of formal public transport; and
- Assess the influence of travel cost and time (and other service attributes) on the likelihood of choosing a formal mode over existing informal options.

By addressing these objectives, the study explores whether a "formal" public transport system (such as a scheduled bus or shuttle service) could offer a sustainable and convenient alternative in Oshana. It also examines commuter trade-offs between cost, convenience, and safety, and considers the practical viability and financial sustainability of introducing formal services in a context dominated by informal transit.

2. LITERATURE REVIEW

2.1 Public Transport in Sub-Saharan Africa and Namibia

Public transport systems in Sub-Saharan Africa (SSA) are often characterised by informality and fragmentation (Booysen *et al.*, 2022). In many SSA cities, a large share of commuters rely on minibuses, vans, or shared taxis that operate without fixed schedules and routes. Such paratransit solutions have arisen to meet demand where formal systems are lacking, but they pose challenges for regulation and long-term sustainability. For example, in South Africa, paratransit (minibus taxis) dominates urban transport but operate with minimal regulation, leading to issues of safety and reliability (Gumbo & Moyo, 2020). These issues are echoed across SSA, including Namibia, where taxis account for roughly 90 % of public transport trips (Ambunda & Nakale, 2020).

Namibia's public transport, as in other SSA countries, consists of a mix of modes: informal shared taxis, a limited number of municipal busses, and some intercity busses. However, the informal taxi industry has effectively become the primary mode, directly competing with the few formal municipal buses available (Madejski *et al.*, 2016). The dominance of informal taxis means that formal services struggle to gain ridership, and government-subsidised buses operate under capacity. In Namibia's cities, including the northern towns of Oshana, the current state is that informal taxis are the de facto public transport system. These are typically sedan cars (commonly carrying 4 to 5 passengers) operating on a semi-fixed route or demand-responsive basis. They depart when full and often have relatively short wait times due to their ubiquity (Ambunda & Nakale, 2020). While this provides flexibility and frequent service for users, it comes with downsides: higher per trip costs (compared to what a mass transit fare might be), poor safety records, and no fixed timetable.

Past studies in the region have highlighted issues of affordability and safety in these informal systems. A study by Ambunda and Nakale (2020) notes that Namibia's informal transport system, though widespread, is considered unsafe and unaffordable by many users. Notably, few formal alternatives currently exist in northern Namibia. Municipal or formal bus services are scarce outside the capital (Windhoek) (Martinussen, 2019; Ambunda & Nakale, 2020). The MR92 corridor that connects Ondangwa, Ongwediva and Oshakati has no dedicated public bus line, despite being a major axis of travel. This gap suggests an opportunity for introducing formal public transport to improve connectivity and sustainability. Similar contexts in other African regions have shown that when introduced properly, formal services (buses or bus rapid transit) can attract commuters and improve overall mobility, but only if they address the service quality gaps that informal systems fill (like frequency and coverage).

2.2 Factors Influencing Mode Choice

Understanding why commuters choose one mode over another is essential for designing a viable public transport service. Random Utility Theory (RUT) provides a framework, suggesting that individuals make mode choices by maximising perceived utility (benefit) of a mode given its attributes (McFadden, 1974). This theory has been widely used to analyse transport behaviours in various contexts, including urban and rural settings (de Luca *et al.*, 2019).Various studies globally and in Africa have identified a range of factors that significantly affect mode choice decisions (Malichová *et al.*, 2022; Mwale *et al.,* 2022).

The cost of a trip is often a decisive factor, especially in low-income settings (Cartenì *et al.,* 2017; Lim *et al.,* 2023). Lower fares can attract cost-sensitive users, whereas higher costs deter them. A study by Cartení *et al.* (2017) found that students' transport choices were highly sensitive to cost differences. In Namibia, where unemployment is high and incomes are low for many, the affordability of a new bus service will be crucial.

Accessibility and convenience are also key factors in mode choice decisions. How easily people can reach a public transport stop (access time) and how frequently the service runs are critical (Brussel *et al.,* 2019; Lim *et al.,* 2023). Many will prefer readily available taxis if a formal service requires a long walk to a bus stop or has infrequent departures. Previous studies have highlighted the accessibility of transport infrastructure as a key determinant of usage (Hardinghaus & Papantoniou, 2020; Washington *et al.*, 2021). A study by Washington *et al.* (2021) noted that in Durban, poor access to bus stops significantly affected bus usage. In the SSA context, if a bus only runs every 30 minutes but taxis are available every 5 minutes, convenience alone can keep users in taxis.

Total travel time, including waiting and in-vehicle time, also influences mode utility. Shorter and more reliable travel times make a mode more attractive (Alade *et al.*, 2019; Kgwedi & Krygsman, 2019). In SSA, it's reported that only 31.7% of the population can access any public transport within a 500 to 1 000 m walk, and many face long travel times for daily commutes (SLOCAT, 2023). If a formal bus significantly reduces or increases travel time compared to taxis, this will affect its uptake.

The qualitative aspects such as comfort (seat availability, crowding, vehicle condition) and safety (driver behaviour, road accident risk, personal security) also play a crucial role. While harder to quantify, these factors often emerge in individual attitudes and perceptions (Das *et al.,* 2021; Lim *et al.,* 2023). Comfort has been shown to impact satisfaction and willingness to use public transport. Das *et al.* (2021) observed a shift from public to private modes when concerns like hygiene (especially during the COVID-19 pandemic) arose, indicating that perceived health safety can also influence choice.

Socio-demographic characteristics such as age, income, gender, and education level influence mode choice both directly and indirectly (Kariuki, 2020). Higher-income individuals may have the option of private cars and thus are less inclined to use any form of public transport unless it offers clear advantages (Arroyo *et al.*, 2020; De Oña *et al.,* 2021). Younger commuters might be more open to trying new modes or enduring slightly longer travel if cheaper, whereas older individuals might prioritise comfort and reliability (Prieto *et al.*, 2017; Rocha *et al.*, 2023). Prieto *et al.* (2017) found specific demographic drivers (like age and household size) affect car-sharing adoption in urban areas, which parallels mode choice tendencies in transit.

Environmental and weather conditions are also key factors in mode choice. Harsh weather (extreme heat, rain) can deter people from using modes that involve walking. In Namibia, high temperatures and seasonal rains can discourage walking to a bus stop, whereas taxis often pick up passengers closer to home. Several studies have shown that weather conditions significantly impact the attractiveness of modes like biking or waiting for a bus (Li, 2019; Lin *et al.*, 2020).

Studies have shown that cost, time, accessibility, comfort, and personal circumstances collectively shape mode choice. To make formal public transport a viable option in a place like northern Namibia, a new service must be designed (or at least considered) with these factors in mind – offering competitive travel times and costs, easy access, and acceptable comfort and safety.

3. METHODOLOGY

3.1 Study Area and Sample

The study was conducted in the Oshana region of Namibia, focusing on the towns of Ondangwa, Ongwediva, and Oshakati, which are linked by the MR92 main road (Figure 1). These towns form the core of Oshana's economic activity and together house a significant portion of the region's 230 800 inhabitants (NSA, 2023). The MR92 corridor is the primary route for public transport in this area. Figure 1 shows a map of the study area and illustrates the MR92 route and the three towns.

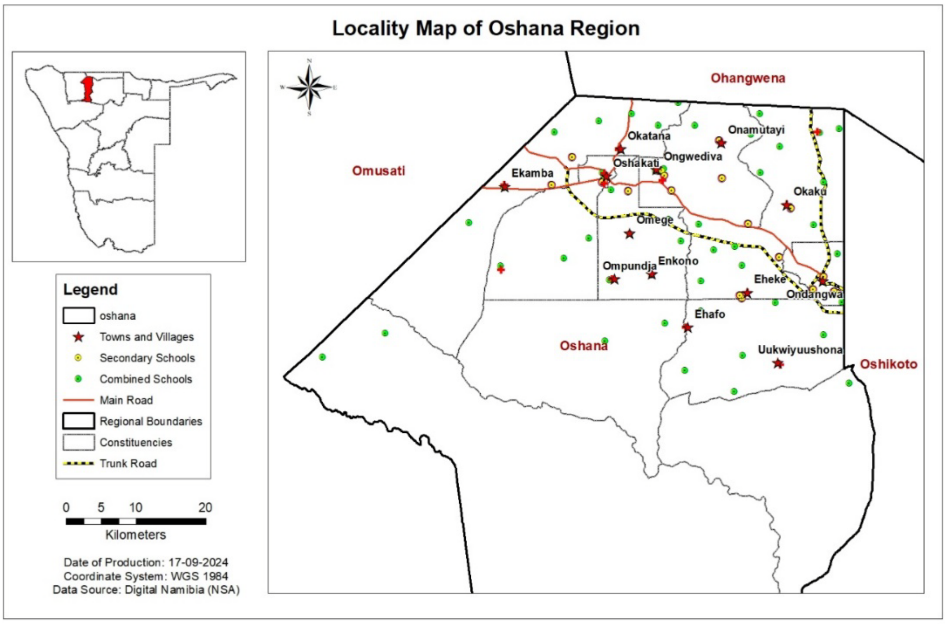

Figure 1: Location of Oshana region and study towns

Based on Oshana's population and a 95% confidence level (α=0.05), a sample of approximately n = 399 was calculated as the target. This sample size would yield a margin of error of about ±5% for survey proportions, thus being statistically representative of the commuter population in the area. Ultimately, the study approached 399 potential participants; of these, 283 provided complete responses (see Section 4.1), yielding a sufficient sample for analysis.

The sample was drawn using a combination of convenience and purposive sampling at key transport nodes. All respondents were current public transport users (primarily taxi users) intercepted at taxi ranks and popular stops along the MR92. The study excluded private car users, with the choice being made to focus on those immediately likely to use a formal service. Respondents were adults (age 18 or above), which means any students in the sample were tertiary-level students, given the age criterion (no secondary school minors were surveyed). Both genders were included, and the study ensured a mix of income and education levels to capture diverse socio-economic perspectives.

3.2 Data Collection Instruments

The study employed multiple research instruments to capture both quantitative and qualitative data, namely a stated preference (SP) survey, an origin-destination (O-D) survey, and semi-structured interviews.

The SP survey was the core quantitative tool, which was designed to present commuters with hypothetical mode choice scenarios. It asked respondents to choose their preferred option among three modes for traveling along MR92: (1) a formal bus, (2) a formal shuttle/shared minibus, and (3) the current informal taxi. These modes and their attributes were carefully defined based on realistic conditions and secondary data. In particular, the travel times, wait times, and costs for each mode scenario were set using information from a feasibility study by GIZ (2021) and local knowledge of current taxi operations. For this study, the bus option was described as taking 30 minutes travel time with a 45-minute waiting time (due to low frequency), a fare of N$10, and average comfort; the shuttle (a smaller formal minibus) had 10 minutes travel time, 20-minute wait, fare N$15, and good comfort; the taxi was 15 minutes travel time, 5-minute wait (reflecting high frequency), fare N$20, with excellent comfort (few passengers). These attributes were intended to simulate a realistic trade-off: the bus is cheapest but slowest, the taxi fastest but most expensive, and the shuttle intermediate. By capturing respondents' stated choices among these, we aimed to infer the proportion willing to switch to a formal mode and which factors (cost vs. time, etc.) influenced that choice. The SP survey was administered via a structured questionnaire. It included additional Likert-scale questions where respondents rated how strongly various factors (cost, convenience, etc.) affect their mode decision. This allowed us to statistically test the importance of each factor (see Section 3.4).

Origin-Destination (O-D) Survey, alongside the SP questions, gathered origin and destination data for each respondent's typical commute on MR92. Participants identified where their trip usually starts and ends, and the distance or time involved. The purpose of the O-D survey was to map travel patterns and distances in the corridor. This information complemented the SP data by showing practical constraints. An example would be if many travellers come from villages far off the main road, that indicated long access times to any formal bus stops. O-D results also helped to interpret whether those with longer or shorter trips responded differently to the SP scenarios. Essentially, the O-D data provided context on the spatial gap a formal service would need to cover.

The study also conducted semi-structured interviews with a subset of 20 respondents (selected to represent different demographic groups) to delve deeper into the qualitative insights. The interviews followed an interview guide (open-ended questions) that probed reasons behind mode preferences, perceptions of the current taxi system, and attitudes toward a possible formal bus. The interviews allowed participants to voice concerns or motivations not fully captured by the survey choices. This was crucial for understanding issues like personal security, reliability, and cultural habits. The interview data thus helped explain the "why" behind the quantitative patterns.

By using multiple instruments, the study sought to triangulate findings: the SP survey provides hypothetical preference data, the O-D survey gives actual travel behaviour, and the interviews offer explanatory depth. While this multi-method approach required more effort, it strengthens the validity of conclusions by covering different dimensions of the study.

3.3 Data Analysis

The study employed both quantitative and qualitative analysis techniques to address the research objectives. For the survey data, the study first performed data cleaning and coding. The frequencies and percentages were computed for key variables, such as current mode usage, demographic attributes, and responses to each SP choice. Table 1 in the results section summarises the socio-demographic profile of respondents. These descriptive statistics set the stage for deeper analysis by highlighting patterns.

To test the significance of associations and preferences, the study used the chi-square (χ^2) statistical test. Specifically, Pearson's chi-square tests were applied in two ways: (1) to each Likert-scale factor question (to see if responses were skewed towards "agree" or "disagree" indicating a significant perception of that factor's importance), and (2) to test the relationship between respondents' characteristics (or factor attitudes) and their SP choice. For example, the study examined if the preference for the formal bus vs. taxi was independent of income level. In practice, for the factor influence questions (rated on a 5-point scale from "strongly disagree" to "strongly agree" that a factor influences their mode choice), the study collapsed responses into agree/neutral/disagree and tested if the distribution was significantly tilted toward agreement. A significant chi-square result ($p < 0.05$) for a factor indicated that a majority felt that factor influenced their choice (rejecting the null hypothesis of no particular opinion.

Interview transcripts were analysed using a thematic coding approach. The study identified common themes and recurring sentiments, such as concerns about safety, convenience of taxis, views on cost trade-offs, and suggestions for formal service. The qualitative findings were integrated into the discussion to explain and supplement the survey results.

All quantitative analyses were done using SPSS. The data was checked for consistency and no issues of multicollinearity and other statistical anomalies arose since the analysis was largely bivariate. Overall, by combining these analysis methods, the study aimed to provide a comprehensive understanding of mode choice preferences and their determinants.

4. RESULTS

4.1 Response Rate and Sample Profile

Out of the 399 targeted questionnaires, 82 were not returned, and 34 were returned only partially completed. This left 283 fully completed responses, corresponding to a response rate of 70.9%, which is adequate for analysis (above the commonly accepted 70% threshold for surveys (Kothari and Garg 2014). The relatively high response rate can be attributed to the in-person administration and the relevance of the topic to respondents.

Table 1 summarises the socio-demographic characteristics of the 283 respondents. The sample was majority female (69%), and skewed young. About 62.5% of respondents were aged between 18 and 30 years, with only 12.4% above age 40 years. Notably, no respondents were above 50 years old, likely a result of sampling at taxi ranks (younger people are more frequent users) and the possibility that older individuals in the region rely on family or do not travel as often using public transport.

In terms of education, the sample was quite educated. 63% of the respondents had a university degree, and roughly 37% had secondary or diploma level education. None of the respondents reported only primary education or no schooling. This could indicate either that such individuals are underrepresented among public transport users surveyed, or they were less inclined to participate in the survey. For income, previous studies have reported that income plays a significant role in determining transport modal choice decisions (Cartenì *et al.,* 2017; Lim *et al.,* 2023). It is thus important to understand the economic situation of the respondents and its impact on modal choice. The results on monthly income levels varied widely, from under N$1 000 to over N$10 000. A significant portion (37.1%) of the respondents earned more than N$10 000 per month (relatively high income in the local context), while about 44 % earned below N$5 000 (with 6% under N$1 000 and 13% under N$3 000). This diversity in income suggests the sample captured both low-income riders (for whom cost might be critical) and middle-income riders. However, the high representation of higher-income and highly educated young adults in the sample could be that this demographic uses taxis to commute to work or tertiary institutions in town. The demographic results are summarised in Table 1.

Table 1: Socio-demographic profile of respondents (n=283)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	88	31.1
	Female	195	68.9
Age	18–30 years	177	62.5
	31–40 years	71	25.1
	41–50 years	35	12.4
	Over 50 years	0	0
Highest Education	Secondary (high school)	53	18.7
	College Certificate/Diploma	52	18.4
	University Degree	178	62.9
Monthly Income	< N$1,000	18	6.4
	N$1,000–2,999	36	12.7
	N$3,000–4,999	71	25.1
	N$5,000–6,999	15	5.3
	N$7,000–8,999	18	6.4
	N$9,000–9,999	20	7.1
	≥ N$10,000	105	37.1

Note: “Above 50” age category had 0 respondents. No respondents had only primary education.

4.2 Current Travel Patterns on the MR92 Corridor

For the purpose of this study, it was useful to understand respondents' current travel behaviour in relation to stated preferences for hypothetical modes. The vast majority of respondents use shared taxis as their primary mode of public transport. As shown in Figure 2 (based on survey data), 62.2% reported that they usually take a taxi when traveling along MR92. Meanwhile, 19.1% said they use "buses" and 12.7% use "metro buses." In the local context, the term "bus" likely refers to private intercity buses or long-distance coaches that some use between towns, and "metro bus" refers to the limited formal town bus service (perhaps in Oshakati) that a small fraction use. A minority (6.0%) mentioned using shared shuttles (informal minibuses or kombis). These results confirm that paratransit (taxis) dominate current mobility on the corridor (main mode), aligning with national trends (Martinussen, 2019; Jones et al., 2022). The combined share of any type of formal bus is around 32% (19.1% and 12.7%), which indicates that about one-third do occasionally use some bus service (likely for inter-town travel), but the convenience of taxis keeps their usage high.

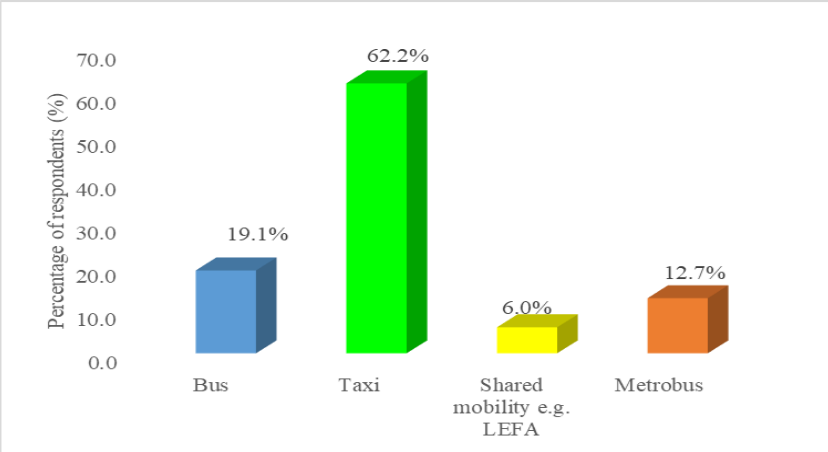

Figure 2: Main public transport mode used when travelling along the MR92 corridor

The O-D data showed a polarised pattern in terms of how far people live from major roads or stops (this is also highlighted in the area serviced by the MR92 in Figure 1). When asked "How long does it take to walk from your home to the nearest public transport pickup point?", about 37.9% of respondents said 5-15 minutes, while a striking 62.1% said it takes 50 minutes or more (Figure 3). This suggests that a significant portion of respondents live in areas not directly served by frequent transport, possibly in peri-urban or rural settlements where they must walk a long distance (or take intermediate transport) to reach the main road. The gap in response categories (15 minutes vs. 50+ minutes) reflects the real and perceived relatively quick access and very poor access. This is despite the survey not explicitly offering intermediate ranges like 20-30 or 30-50 minutes and allowing open ended responses on access times. This finding underscores an accessibility challenge were many people in the region are quite far from formal stops, meaning even if a formal bus ran on MR92, those 62% might still need to take a taxi or endure long walks to reach the bus. These findings also support the findings by SLOCAT (2023), that public transport access is a challenge in Sub-Saharan Africa on average, with only 31.7% of the population accessing either formal or informal public transport within a walking distance of between 500 and 1 000 metres.

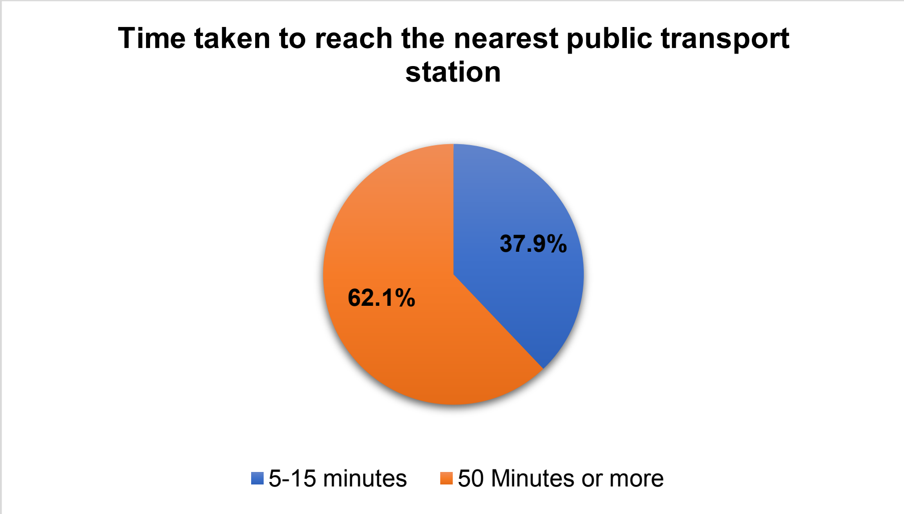

Figure 3: Time taken to reach the nearest public transport station

In terms of trip length along MR92, most respondents travel between the three towns (a stretch of roughly 30 to 40 km end-to-end). Trips are largely one directional depending on the time of day. This could be from Ondangwa to Oshakati in the morning and back in the evening (for work or school). A high number of respondents (about 45 %) travel the full length of the corridor (Ondangwa to/ from Oshakati), which by taxi takes about an hour. Others travel between intermediate points (e.g., Ongwediva to Oshakati, a shorter trip). These patterns are important when considering a formal bus service. A bus could cater to through movement travellers efficiently, but those with shorter trips or who live far off the route may not benefit as much.

Overall, the results indicate the current usage is heavily skewed to taxis, and access to transport infrastructure is a serious issue (most either have very short or very long access times) that would need to be addressed to ensure equitable access and mobility for all users.

4.3 Stated Preference (SP): Preferred Mode Under Hypothetical Options

The study presented each respondent with a choice scenario (as described in Section 3.2) comparing a Bus, Taxi, and Shuttle option with specific attributes (Table 2 presents the attributes given). The travel costs used in the SP survey were adopted from a report by GIZ (2021). Respondents were asked "If these were your options for traveling along MR92, which would you prefer?" Importantly, this scenario was framed as if all three services were available concurrently.

Table 2: Stated preference scenario options results

Mode Option	In-Vehicle Time	Waiting Time	Access Time (walk)	Fare (N$)	Comfort	Convenience	Service Frequency	% Choosing as Most Preferred
Formal Bus	30 minutes	45 minutes	15 minutes	N 10	Average	Average	Every 30 mins	12.5
Informal Taxi	15 minutes	15 minutes	10 minutes	N 20	Excellent	Excellent	~Every 5 mins (on demand)	53.8
Formal Shuttle	10 minutes	20 minutes	10 minutes	N 15	Good	Good	Every 15 mins	33.8

As Table 2 shows, over half of respondents (53.8%) chose the Taxi option as their preferred mode in the hypothetical scenario. About 33.8% chose the Shuttle/shared minibus, and only 12.5% chose the Bus option. This indicates that, given the attribute levels set by the study, the informal taxi remains the most attractive option to the majority. The taxi was characterised by the shortest waiting and access times and highest comfort (but at the highest cost). The results suggest many people are willing to pay more (N$20 vs N$10) to save time and enjoy convenience. This reflects the value placed on frequency and door-to-door service.

The bus option, despite being half the fare of a taxi, attracted only one in eight respondents. The 46.2% combined that chose either the bus or shuttle can be interpreted as those willing to shift to a "formal" mode (since both bus and shuttle represent formal services, in contrast to the status quo taxi). The 46.2% (respondents) willing to choose a formal public transport mode is a critical finding by the SP survey. It implies that under the given conditions (which include a fairly inconvenient bus service), nearly half the current users might consider a formal alternative. Conversely, it also means a slight majority (53.8%) would stick with the informal taxi given its speed and frequency advantages. The reasons for these preferences align with the attributes that taxis offer short waits and high frequency (a taxi can be found in 5 minutes) and relatively short travel time, which is very appealing for time-sensitive travellers.

Shuttles, which the study pitched as somewhat faster than taxis and cheaper, got a significant share, indicating interest in a shared mode that is a middle ground – some respondents commented (in follow-up questions) that a shuttle at N$15 with moderate wait is acceptable, especially if it's less crowded than a bus. The bus fared poorly mainly because of the long waiting time (45 min) associated with it (only two departures per hour). Some interviewees explicitly said they "wouldn't want to wait nearly an hour for a bus" even if it's cheap. This reflects the current reality (taxis are ubiquitous and often readily available). Taxis are ingrained in the daily lives of Namibians and are often seen as the default mode of transport (Ambunda & Nakale, 2020). Unless a new bus or formal service can dramatically close the gap in frequency and convenience, many of the respondents will not switch modes.

4.4 Factors Influencing Mode Choice (Chi-Square Analysis)

Beyond the direct mode choice, the survey asked respondents to rate the importance of various factors in their decision to use or not use a formal public transport option. The study listed several factors (presented in Table 3) corresponding to those identified in the literature. Respondents indicated their level of agreement with statements such as "Travel cost influences my choice of transport mode" on a 5-point scale. The study then analysed these responses to see which factors most people agreed were influential. Table 3 presents the results of chi-square tests for each factor. For each factor, the study tested the null hypothesis that responses were evenly distributed (no strong agreement or disagreement overall). A significant chi-square with $p < 0.05$ indicates that the distribution was significantly skewed (most tended to agree the factor is influential). All tests have 4 degrees of freedom ($df = 4$) since there were five response categories (1 through 5 on the Likert scale) and tested against a uniform distribution.

As shown in Table 3, all listed factors yielded statistically significant chi-square results. This means that respondents generally agreed that each of these factors influences their transport decisions. The factors were all perceived as important by the sample. Among these, some factors had higher chi-square values, hinting at a more unanimous agreement. The socio-demographic factors and travel behaviour have extremely high χ^2 (281.1 and 280.7 respectively). These are however broad categories. The agreement here likely reflects that people recognise their personal circumstances (and perceptions) and habits play a role in mode choices and shape preferences, expectations, and accessibility. The findings support the results from several studies on transport mode choice (Prieto *et al.,* 2017; Arroyo *et al.,* 2020; De Oña *et al.,* 2021; Rocha *et al.*, 2023).

Table 3: Chi-square test results for factors influencing mode choice decisions (N = 283, df = 4 for each)

Factor	χ^2 Statistic	p-value (α = 0.05)
Travelling costs (affordability)	197.9	0.000 (**significant**)
Accessibility of service (distance/time)	233.1	0.000 (**significant**)
Convenience (ease, flexibility)	178.8	0.000 (**significant**)
Comfort (seating, crowding)	229.4	0.000 (**significant**)
Hygiene & health concerns	206.7	0.000 (**significant**)
Personal attitudes & perceptions	217.2	0.000 (**significant**)
Socio-demographic factors (e.g. age/income)*	281.1	0.000 (**significant**)
Travel behaviour (habits, frequency)	280.7	0.000 (**significant**)
Environmental/weather conditions	166.2	0.000 (**significant**)

Note: All factors tested show $p < 0.001$, indicating a strong consensus that each factor affects mode choice.

More interesting are accessibility (233.1) and comfort (229.4) factors which were very high, indicating that nearly everyone agrees that they are key in mode choices. Indeed, accessibility came up frequently in interviews as a limiting factor for bus use. Users prefer the most accessible public transport option. This is also revealed in the SP survey results in Table 2. Similarly, a previous study such as Hardinghaus & Papantoniou (2020), found that the accessibility of modes and infrastructure significantly influences individuals' transport modal choices. Also, comfort is crucial for public transport users as it reduces physical strain, enhances satisfaction, and encourages regular use. It makes travel more appealing, safe, and inclusive, especially for long journeys or vulnerable passengers. These results corroborate findings in several studies (Das *et al.,* 2021; Lim *et al.,* 2023).

The cost and affordability of travel (197.9), while slightly lower, was still very strongly agreed upon as a deciding factor. This is not surprising in a mixed-income group. These results align with the findings by Cartenì *et al.* (2017) and Lim *et al.* (2023) that travelling cost is a significant determinant of transport mode preferences. The results from the SP survey (see Table 2) do however indicate that a balance between travel costs and other factors can also affect the mode choice of respondents, especially when time and availability of modes come into play. The results show that convenience and climatic conditions (178.8 and 166.2 respectively) had the lowest χ^2 of the set, but still significant. It is expected that users as rational decision-makers utilise the transport mode that is convenient to them. The results confirm previous findings by Alade *et al.* (2019) and Kgwedi & Krygsman (2019). Climatic conditions influence mode choice. Adverse conditions consequently lead to road safety issues, accessibility challenges and delays. Thus, such conditions inform users choices. These results confirm the findings of several studies on the impact of climatic conditions on mode choices (Li, 2019; Lin *et al.*, 2020).

Even though this analysis does not explicitly indicate which mode is preferred, it does confirm that these dimensions need to be considered in the planning of any public transport system in northern Namibia. The unanimous nature of these responses might be partly due to response bias (people tend to rate everything as important). However, the results align with expectations that issues like cost, convenience, and accessibility affect whether they would use a formal transport service.

Through cross tabulating, the study also observed some associations between demographics and SP choices. The findings indicate that younger respondents (between 18 and 30 years) were slightly more likely to choose the shuttle or bus in the SP scenario than older respondents, though the difference was not statistically huge. This possibly indicates that this demographic (younger riders) are more open to new modes. The study also found that higher-income respondents were less cost-sensitive in their choices. This demographic of respondents still chose taxis despite the higher fare, whereas lower-income respondents tilted a bit more toward the bus (the cheapest). This finding indicates income plays into the willingness to trade time for money.

Gender did not show a huge difference in SP choice in the study sample. Both men and women had similar preferences distributions (though some female interviewees emphasised safety more, this did not translate to choosing the bus in SP, possibly because the bus offered wasn't perceived as significantly safer in the scenario).

5. DISCUSSIONS

5.1 Dominance of Taxis and Barriers to Shift

The results provide a nuanced picture of mode choice dynamics on the MR92 corridor The findings confirm that informal taxis currently dominate the transport landscape, with about 62 % of commuters using them regularly and a majority (53.8 %) still preferring them even when presented with formal alternatives in the SP scenario. The primary reason is clear, that taxis offer unmatched convenience and frequency. With wait times of only a few minutes and the ability to board almost anywhere along the route, taxis provide a door-to-door service that formal buses would struggle to match without significant infrastructure (like many closely spaced stops or feeder services). This convenience factor is compounded by personal habits. Many commuters view taxis as the "default" mode and are comfortable with how the system works (despite its flaws). As one interviewee put it, *"I know the taxi will come to my house, a bus won't"*. This reflects an ingrained habit and expectation, which is a barrier a new system must potentially overcome.

Another major barrier identified is the accessibility issue. The results that 62% of respondents have to travel over 50 minutes (likely walking) to reach public transport suggests that many live in dispersed or peri-urban areas. For these individuals, a formal bus on the main road is not a complete solution. They would need reliable last-mile connectivity. Currently, many likely use a taxi for that last-mile (or even hire a private taxi if they live far from the taxi rank). This means that without complementary measures, a formal bus might only attract those living relatively near the main road. This is a critical viability issue, as the coverage gap reduces the pool of potential bus users. Essentially, "first and last mile" distance is a big hurdle, one that informal taxis naturally solve by reaching into neighbourhoods. Furthermore, personal security and comfort considerations favour taxis to some extent. While taxis in Namibia are not without safety issues (there are concerns about reckless driving and crime in some cases), many commuters feel a sense of familiarity with taxi drivers or fellow passengers, and some interviewees expressed distrust in a new system: *"What if the bus leaves me behind? At least with a taxi I can negotiate"*. This cultural inertia means uptake of formal transport could be slow even if objectively beneficial.

5.2 Willingness to Shift and Conditions for Viability

Despite the dominance of taxis, it is noteworthy that approximately 46 % of respondents indicated willingness to use a formal public transport mode (bus or shuttle) in the SP scenario. This suggests a significant latent demand for formal services. Nearly half the commuters are open to something other than taxis *if* it meets some of their needs. The shuttle option's popularity (33.8 %) indicates interest in a mode that perhaps combines some advantages of both systems. From the SP attributes and follow-up questions, the study inferred conditions under which the 46 % of respondents (and potentially more) would actually shift. More so, the findings point to several actionable opportunities for making formal public transport a viable and even preferred option in Namibia's MR92 corridor and similar contexts. These include:

- Service frequency (and reliability) and waiting time: Taxis effectively have a frequency of "a few minutes" because there are so many on the road. The studies hypothetical bus was every 30 minutes, which most found too infrequent. Many interviewees said a bus would be attractive only if it came at least every 10-15 minutes during peak times. In practical terms, a formal bus service would need a high frequency (less than or approximately 15 min intervals) to compete. If a formal service runs too infrequently, it risks low ridership (a vicious cycle leading to even poorer frequency). So, frequency is the "tipping point" factor. A bus arriving every 10 minutes might shift the balance significantly toward formal transport.
- Comfort, safety and capacity: Many respondents agreed comfort matters, and some choosing the shuttle might have done so imagining it less crowded than a bus. Thus, ensuring good comfort levels could help attract and retain riders. Air conditioning, cleanliness, and safety measures on buses would also target the hygiene and health concerns highlighted by respondents. Emphasising that a formal bus is a safer and more comfortable experience could sway more people who currently tolerate taxis but don't particularly enjoy them.

Achieving the above requires addressing the financial and operational challenges through a phased approach. Perhaps starting with peak-hour services when demand is concentrated and to integrate the informal sector rather than displacing it entirely. This could reduce resistance and ensure local knowledge is utilized. Eventually, the formal system could also attract some current car users if it becomes efficient (a longer-term goal aligning with Namibia's climate commitments).

6. CONCLUSION

The study has shown that while informal taxis currently dominate in Namibia's northern towns, there is a substantial opportunity and demand for formal public transport. Nearly half of current commuters are open to switching under favourable conditions. Key factors such as cost, accessibility, convenience, comfort, and safety significantly influence mode choice decisions, and any formal system must address these to succeed. The findings underline that "formal" public transport can be a viable option if it is implemented in a user-centred way - frequent, affordable, safe, and integrated with existing travel patterns.

Moving to a more formalised public transport system offers broader benefits aligned with sustainable development goals. It can improve equitable access to mobility (benefiting low-income and rural populations), reduce aggregate travel costs, and potentially lower traffic congestion and emissions by consolidating trips. For northern Namibia, introducing a formal bus service on corridors like MR92 could serve as a pilot for potentially scaling up across the country and contributing to Namibia's climate change mitigation commitments by promoting a shift from numerous fuel-inefficient taxis to fewer, more efficient vehicles.

A formal public transport system in the Oshana region is not only viable but also necessary for long-term sustainability. By learning from the current mode choice patterns and explicitly addressing the barriers identified (long waits, poor last-mile access, etc.), policymakers can design a public transport service that residents will use and support. The study recommends proceeding with incremental implementation of formal transport solutions (supported by the integration of existing services), closely monitoring performance, and iteratively improving the service. With commitment and smart planning, Namibia can transition toward a more sustainable, inclusive, and formalised public transport network, with various levels of integration with existing modes to enhance mobility and access for all.

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