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Residents' cycling perception as a fundamental alternative to cycling promotion in Calabar, Southern Nigeria

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Abstract

A successful bicycle policy is dependent upon the ability of policy administrators and other stakeholders to effectively understand the attitude, preferences, intentions, perceptions and socio-cultural characteristics of residents. An in-depth analysis of residents' cycling perceptions and city-level characteristics was attempted using 3,000 cycling instruments from the University of Calabar survey with a success rate of 79% (2,370). Based on findings of earlier studies, 33 cycling related variables (perception, land uses and city traffic characteristics) were identified and presented for rating by respondents. An Exploratory Factor Analysis (EPA) was conducted on the 33 items with orthogonal rotation (varimax). The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO=.77 while Bartlett's test of sphericity ($\chi^2(528)=1.935$, $p<.001$ indicated reasonably large correlations for pca. however an initial analysis was run to obtain eigenvalues each component in the data which shows components having eigen values over kaiser criterion of and combination explained variance. these formed basis extraction naming factors including: commercial major roads residential neighbourhoods mixed neighbourhood cycling trip purpose ridership frequency with pleasant view security economic environmental cost long length. study recommended enlightenment campaigns especially schools policy development enhance cyclists safety as counselling strategies effective promotion calabar.

Keywords: Cycling; Perception; Land Use; Willingness; Exploratory Factor Analysis

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1. Introduction

Cycling is an environmentally sustainable non-motorized transportation method which does not pollute the environment and requires much less space in terms of land use than other forms of motorized transport. It involves the use of bicycles for transport, recreation, or for sport. Cycling is a moderate-intensity physical activity and is independently associated with many health benefits. It has unique potential to support an active lifestyle when it could be integrated into daily travel routines. In many countries of Europe, America and Asia, there is growing interest in the promotion of utilitarian cycling to work, school, and shopping. Bicycle transportation appears to offer great opportunity for behavioral change in Africa and Nigeria in particular. The argument that while automobile crashes in developed countries have reduced considerably, there are on the increase in developing countries which justifies safety concerns often expressed by utilitarian cyclist in cities of the third world, is tenable. Utilitarian cycling is observed to be associated with accidents and other injuries (Thompson and Rivara, 2001) and exposure to some level of air pollution (Peters et al., 2004). The benefits of cycling far outweigh the risks associated with its use. Pucher and Dijkstra (2003) observed that cycling and walking offers valuable cardiovascular exercises. Other advantages of cycling-related transport include minimum operational space, economical cost of travel to the traveller and the environment. It also enhances the liveability and liveliness of cities, enhances safety in central areas of cities, and fosters social cohesion in urban environment, among others. However, most public discussions on transport problems often focussed on air pollution and its impacts on health.

An understanding of the perception of residents has become fundamental for effective bicycle policy formulation and promotion. Developing these policies for increased used of utilitarian cycling requires knowledge of the general perception of factors that influence ridership. Socio-demographic factors such as age, gender, income, education, ethnicity, cycling experience, and commute distance, as well as community-level factors such as safety, weather, traffic, topography, cycling infrastructure, land use integration, and population density have been suggested as determinants of ridership (Nelson and Allen, 1997; Baltes, 1996; Pucher and Renne, 2003). It is argued that much of the evidence to date is based on convenience samples (Antonakos, 1994; Nankervis, 1999), or surveys with low response rates (Decima Research, 2000). This research focused on bicycle ridership possibility among students of the University of Calabar with a view to assessing their perception on factors of cycling. In many cities of the third world, including Calabar metropolis, cycling is perceived as dominating urban transport for the young people (mostly men), the poor and socially excluded, who cycle most often and furthest in a near-absence of cycling infrastructure. Calabar is the capital city of Cross River State, southern Nigeria and lies between longitude 8^{o} 19^{l} 30^{ll} and 8^{o} 25^{1} 30^{11} east of the Greenwich Meridian and latitude 4^{o} 57^{l} 55^{ll} and 5^{o} 40^{l} 30^{ll} north of the Equator (Figure 1). It comprises of Calabar Municipality and Calabar South Local Government Area and occupies an area of about 406 square kilometers. Based on a growth rate of 2.58 per cent and a 2006 baseline population figure of 328,826 (National Population Commission, 2006), the total population is estimated at about 424,222 in 2016. The city is a lowland terrain with highest and lowest points at about 100m and 2m above mean sea level respectively (Okon et al., 2015).

2. Methodology

2.1. Sample

A utilitarian cycling questionnaire was administered to about 3,000 undergraduate, post graduate students, teaching and non-teaching staff of the University of Calabar in November/December, 2016. The multi-stage sampling approach was employed to sample all faculties and all categories of mid-level staff from both Main and New Library Campuses. This was intended to reduce bias as the travel needs of students and mid-level staff (mostly without personal automobile) is similar. This study population is defined strictly by the university boundary and instruments were personally administered to respondents by the authors. Cycling and demographic variables were as extracted from non-motorized transport literature and the national Population commission reports. About 33 cycling factors were conceptualized into a five-scale Likert-scale format including strongly agree to strongly disagree. This is exclusive of socio-demographic factors such as age, gender, income, cycling experience, willingness to cycling and so on.

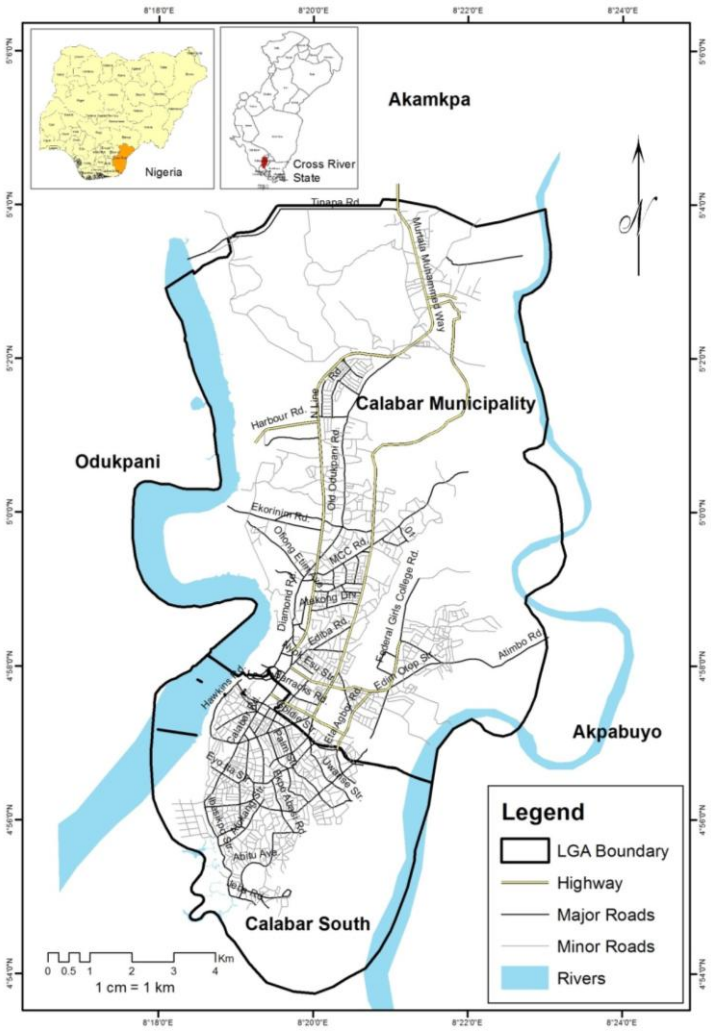

Figure 1. Cross River State showing Calabar metropolis (Calabar Municipal and Calabar South)

2.2. Data

Socio-demographic data of respondents was acquired using the questionnaire. These include gender, age distribution, ownership or access to bicycle, willingness of utilitarian cycling, cycling experience and so on. Further 33 questions on utilitarian cycling were presented for respondents to rate their level of agreement with the statements. Basically, these statements were designed to describe certain cycling conditions with the potential for enhanced cycling volume. The 5-point Likert scale with categories such as strongly agreed, agreed, neither, disagree and strongly disagree was employed. The Likert Scale is an ordinal psychometric measurement of perceptions, attitudes, beliefs and opinions.

In applying the method in this research, each question or statement is presented in a manner in which a respondent is expected to indicate a degree of agreement or disagreement. The attitudes of the population for one particular item in reality exist on a vast, multi-dimensional continuum. However, the Likert Scale is uni-dimensional and only gives 5-7 options of choice, and the space between each choice cannot possibly be equidistant. it thus fails to measure the true attitudes of respondents especially that o, it is not unlikely that peoples' answers will be influenced by previous questions, or will heavily concentrate on one response side (agree/disagree). Respondents often avoid choosing the "extremes" options on the scale, because of the negative implications involved with "extremists", even if an extreme choice would be the most accurate (Komorita, 1963; Baron, 1996; Cross, 2005; Alphen et al., 1994; Li, 2013). Despite its utility in both measurement and substantive research contexts, factor analysis has been criticized. Cronkhite and Liska (1980) observed,

> *'Apparently, it is so easy to find semantic scales which seem relevant, . . . so easy to name or describe potential/hypothetical sources, so easy to capture college students to use the scales to rate the sources, so easy to submit those ratings to factor analysis, so much fun to name the factors when one's research assistant returns with the computer printout, and so rewarding to have a guaranteed publication with no fear of non-significant results that researchers, once exposed to the pleasures of the factor analytic approach, rapidly become addicted to it' (p. 102).*

However, the choice of Likert scale is based on its universal acceptance and easily understood as a survey tool. Other advantages include easily quantifiable responses that are subjective to mathematical computation and analysis allow participants to respond on a degree of agreement rather than restricted to concrete yes or no answer. These responses are very easy to code when accumulating data since a single number represents the participant's response. Likert surveys are also quick, efficient and inexpensive methods for data collection. They have high versatility and can be sent out through mail, over the internet, or given in person (Maurer and Pierce, 1998; Albaum, 1997; Lee et al., 2002; Garland, 1991; Guyatt et al., 1987).

2.3. Data analysis

The data was subsequently coded and inputted in the Statistical Package for Social Sciences (SPSS) where an analysis was carried out. Coding was done in an arithmetically increasing order with 1 for strongly agree to 5

for strongly disagree. About 3,000 copies of the questionnaire were administered on respondents with 79% (2,370) success rate. Descriptive and preliminary analyses were initially carried out to examine study socio-demographic characteristics. Exploratory factor analysis (EFA) was employed in the analysis of data. The methods may often be used with novel or exploratory research scenarios as a precursor to latent variable modeling or confirmatory factor analyses (CFA) (Schumaker and Lomax, 2004). It is used as the focal methodology in this research for reducing a large number of items (33) from 2370 questionnaire to a smaller number of components (10). This helps in uncovering latent dimensions underlying the data set, or examining which items have the strongest association with a given factor. Our decision to further use extracted variables for hypothesis test is consistent with Gorsuch (1983) that 'once a researcher has used EFA and has identified the number of factors or components underlying a data set, he/she may wish to use the information about the factors in subsequent analyses.

Kawashima and Shiomi (2007) used EFA with a thinking disposition scale whose analyses uncovered four factors related to high school students' attitudes towards critical thinking. The factor scores were used to investigate student differences in attitude by grade level and gender. Mee Bell, McCallum and Cox (2003) similarly adopted EFA in their research of cognitive elements underlying reading. The extraction of the factor scores were used in the follow-up multiple regression analyses to investigate the capability of the factors in predicting selected reading and writing skills. As noted by Kieffer (1999), "the utilization of factor analytic techniques in the social sciences has been indelibly intertwined with (both) developing theories and evaluating the construct validity of measures (i.e., scores)".

3. Results

3.1. Study population and descriptive results

The study population consisted of the entire staff and students of the University of Calabar with an estimated population of over 45,000 inclusive of staff and students. A sample size of 3000 with a success rate of 79% (2370) was drawn across faculties of in both campuses (Main Camp and New Library). Descriptive results of the study revealed 56.3% and 43.7% male and female participation respectively. Three age classification was used including <25years (49.4%), 25-40years (38%) and >40years (12.6%). Furthermore, a cross tabulation of undertaken to see the pattern of modal share or preferences (walking 17.9%, cycling, 2.0%, tricycle, 5.7%, vehicle74.2% and combined modes, 0.3%) of respondents based on age distribution and gender. The result showed that more young people <25years do more walking, cycling and vehicle transport in the city (figure 2). This result has great implication in the ability to promote cycling and other related non-motorized transport options in the city. A cycling modal share of only 2.0% portends that much work has to be done in the area of promotion, education and public enlightenment of cycling related transport. in terms of gender and modal distribution, the result shows that more male do more of all modal share than female except for cycling where no female response is recorded or in tri-cycling where female actually using more (3.3%) than their male counterparts (2.5%) (Figure 3).

The study further inquired to know the level of access to bicycle from respondents. For example, 3.6% acknowledged having personal bikes, about 8.8% have access to a bicycle from family/friend while 75.6% do not access to bicycle at all. It therefore suggests that there may be a relationship between access to bicycle and actual bicycle use in the study area. More interesting

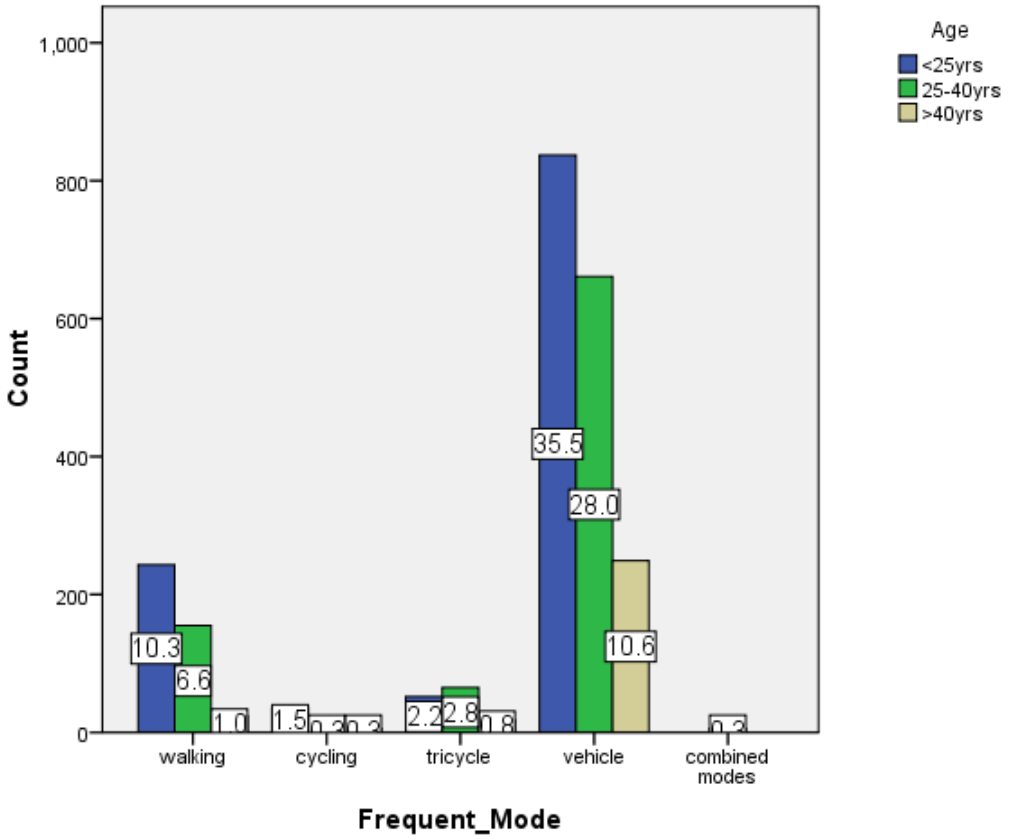

Figure 2. Cross tabulation of modal share and age distribution in Calabar metropolis

revelation is contained in further analysis that shows that 27.5% admits having high cycling experience, 29.3% uses bicycle though inexperience while 43.2% do not have cycling experience at all. Therefore, cycling conditions may have influenced cycling modal share in Calabar. For example, 62.9% are of the opinion that lack of bicycle lanes remain the greatest discouragement to cycling in Calabar. Others such as long trip length (10.1%), fear of stigmatisation of been poor (6%), high motorized volume and speed (8.6%), unfavourable weather such as violent rain storm, hot sun and so on (7.2%), while safety concerns as discouragement factor accounts for 5.2%. furthermore, 15.7% of study participants are most likely to ride to the university without any conditions, 57.1% will most likely ride given certain conditions as above, 19.9% are very unlikely to ride, while 7.4% remain undecided.

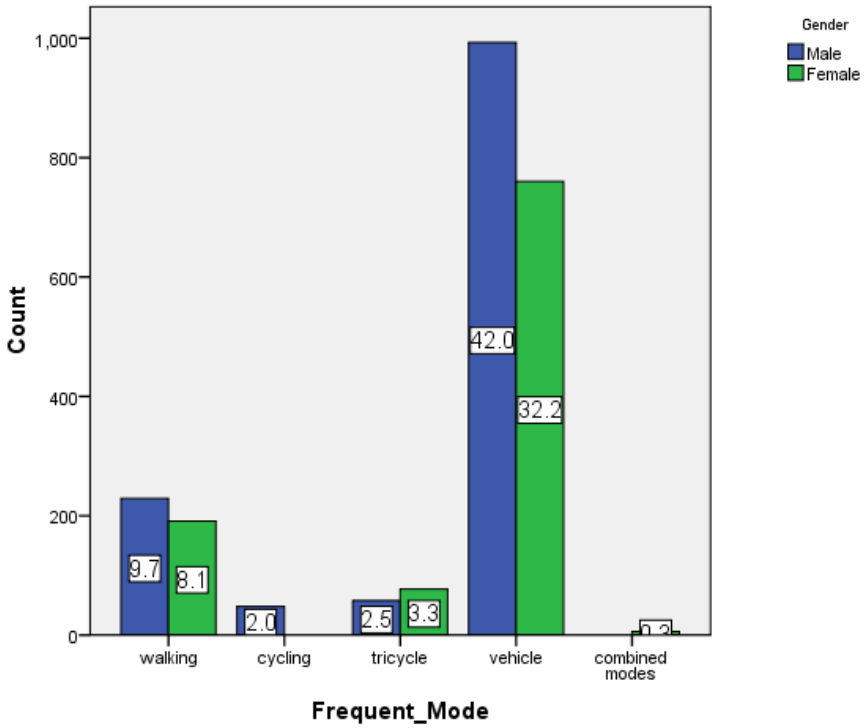

Figure 3. Cross tabulation of modal share and gender distribution in Calabar metropolis

3.2. Exploratory factor analysis (EFA)

An exploratory factor analysis was conducted on the 33 items with orthogonal rotation (varimax). The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis, KMO = .77 'superb' according to Field (2009) and all KMO values for individual items were > .61, which is well above the acceptable limit of .50 (Field, 2009). Bartlett's test of sphericity χ^2 (528) = 1.935, p < .001, indicated that correlations between items were sufficiently large for EPA. An initial analysis was run to obtain eigenvalues for each component in the data. Ten components had eigenvalues over Kaiser's criterion of 1 and in combination explained 58.89% of the variance. The scree plot was slightly ambiguous and showed inflexions that would justify retaining both components 2 and 7. Given the large sample size, and the convergence of the scree plot and Kaiser's criterion on ten components, this is the number of components that were retained in the final analysis. Table 1 shows the factor loadings after rotation. The items that cluster on the same components suggest that component 1 represents commercial major roads, component 2 is residential neighbourhoods, component 3 is mixed neighbourhood, component 4 cycling factors (such as pedestrian lane, stigma, safety), component 5 is trip purpose, and component 6 is ridership frequency. others include, trip length as factor 7, neighbourhood with pleasant view and security as factor 8, economic and environmental cost as factor 9, while the 10th factor that loaded strongly across the cut-off is named as long trip length (see Table 1).

Table 1. Summary of exploratory factor analysis results for the cycling questionnaire (N = 2370)

Item	CMR	RMR	MN	cycling factors	trip purpos	ride freq	short trips	N/ pleasant	Econ/ Envt	long trip
CMR with continuous streets	**.80**	-.07	-.05	.0	.03	-.01	.06	-.16	-.08	.10
CMR with direct path	**.77**	.06	-.06	.05	.07	-.02	-.08	-.20	-.06	-.02
CMR with good street crossing	**.75**	-.05	-.12	-.05	-.07	.01	.06	.05	.01	.12
CMR with pleasant view	**.69**	-.05	-.01	-.04	-.07	.01	.06	.09	-.04	-.07
CMR with security	**.53**	.02	.06	-.02	.03	-.03	-.12	.12	.05	-.25
RN with pleasant view	.0	**.80**	-.04	.03	-.17	.42	.23	-.04	-.10	-.05
RN with security	.01	**.72**	-.16	.05	.06	.02	.43	.11	-.04	.05
RN with good street crossings	.02	**.61**	-.18	-.07	.08	.0	.23	.22	.18	-.07
RN with continuous streets	-.04	**.54**	.0	-.06	.04	-.03	.20	.09	.01	-0.09
Reduced cost of transport	-.05	**.48**	.08	.03	-.03	.02	-.02	-.13	.54	-.04
MN with continuous streets	-.03	.09	**.80**	-.05	-.05	-.05	-.08	-.03	.54	.19
MN with direct path	-.03	.03	**.68**	-.04	.15	-.03	.15	-.16	-.08	.26
MN with good street crossings	.04	-.03	**.67**	-.03	-.19	-.02	.42	-.13	.01	-.12
Because of rain and hot sun	-.05	.16	.08	**.75**	.06	-.15	.20	-.16	-.14	.09
Safety from motorists/thieves	-.04	.20	.09	**.73**	-.04	.02	.07	-.12	-.04	.18
Culture & stigma	-.03	.26	.04	**.71**	.0	-.02	-.11	-.14	.16	.15
Lack of pedestrian lane	.0	.39	-.16	**.55**	-.11	.03	-.01	.07	-.01	-.13
Cycle for sport/racing	.02	.36	-.09	.05	**.80**	-.02	.05	-.20	.13	-.05
Go to work, school, shop	.33	.06	-.06	.05	**.68**	.07	-.02	-.08	-.20	-.06
Cycle for leisure	.35	-.07	-.05	.0	**.52**	.03	-.01	.06	-.16	-.08
Ride a bike on week days	.30	-.05	-.12	-.05	.30	**.80**	0.01	0.06	0.05	0.01
Ride a bike daily	.25	-.05	-.01	-.04	-.07	**.70**	.01	.06	0.09	-.04
Ride a bike on weekends	.15	.02	.06	-.02	.03	**.69**	-.03	-.12	.12	.05
Cycle less than 10km	.02	-.06	.35	.02	.03	-.07	**.61**	-.07	-.01	-.13
Flexibility and speed	-.07	-.05	.43	.02	-.03	.05	**.58**	-.07	-.04	-.02

of travel										
Cycling in MN with security	-.05	-.03	.02	.0	.0	-.05	-.03	**.62**	-.11	.02
MN with pleasant view	.03	-.04	**.41**	.04	-.05	.02	-.10	**.59**	.11	.54
Reduced cost of transport	.04	.02	.03	.27	.07	-.04	-.05	-.13	**.77**	.14
Protect the environment	.04	-.09	.03	.32	.01	.01	-.07	.05	**.73**	.09
Long trip length	-.05	.05	-.07	.34	-.04	.05	-.01	.11	.02	**.67**
Eigenvalues	5.4	2.4	2.1	1.9	1.5	1.5	1.3	1.2	1.1	1.0
% of variance	16.2	7.3	6.4	5.9	4.7	4.5	3.8	3.6	3.3	3.1

4. Synthesis and conclusions

4.1. Naming of factors

The authors have used data mainly from respondents in the University of Calabar to study residents' cycling perceptions in Calabar as a fundamental alternative to cycling promotion in Calabar. After an initial identification of 33 variables, we conducted an exploratory factor analysis in which 10 factors were extracted and renamed having met the Kaiser's criterion of 1 and in combination explained 58.9%. The naming of factors thus reveals major factors with capacity to influence cycling volumes in the city. Each of these factors are summarised below:

4.1.1. Commercial major roads (CMR)

The questions that load highly on factor 1 seem to all relate the impact of cycling along commercial major roads due to the directness of the path, continuous nature of the roads, good street crossings, pleasant view and perceived security. One road with characteristics that best fit this description is the Marian Road. This urban major road has changed the internal spatial structure of Calabar, emerging as a new centre of commercial and recreational activity. It is one of the few urban major roads that are dualised with other basic road infrastructures like pedestrian lane, street lights, high volume of pedestrian and vehicular traffic at low speed especially during peak periods (Figure 5).

4.1.2. Residential neighbourhoods (RN)

This factor relate to residential neighbourhood types with similar characteristics with commercial major roads. The major difference here is the volume of commercial activities, pedestrian and vehicular traffic between them. A general consensus thus suggests that potential cyclists are mostly attracted to streets with direct and continuous path, good street crossings and general pleasantness of the area. The linear orientation of the city (Figure 5) can be explored to provide cycling advantage since it has well planned streets in many residential areas such as State Housing, Federal Housing, Ekorinim, and so on.

4.1.3. Mixed neighbourhood (MN)

This factor also loaded highly as a determinant for potential cycling in the city. It corresponds to questions on mixed land use areas with direct paths, continuous streets and good street intersections.

4.1.4. Cycling factors:

Wide ranges of cycling factors were identified and presented to respondents for assessment as likely determinants of cycling in Calabar. These include the presence of cycling lane, stigmatization of cyclists as poor urban dwellers, insecurity concerns and certain extreme environmental conditions (rain, sun). There loaded quite high and indicates the impact of infrastructure on cycling among residents of Calabar.

4.1.5. Trip purpose:

The purpose of trip such as leisure, sport/racing and work, school, shopping related purposes seem to load highly among respondents as a consideration for cycling. Despite the low cycling modal share, it is observed that the purpose of trip has high influence on cycling in the study area.

4.1.6. Ridership frequency:

The frequency of ridership loaded also highly and corresponds to questions like daily, weekly and weekend ridership. The frequency with which people ride a bicycle has strong relationship with trip purposes. Most respondents admitted riding a bicycle mostly during weekends for recreation purposes.

4.1.7. Short trips

Cycling distances less than 10km loaded highly as a reflection of residents' cycling distance preference. Other questions bordering on flexibility and speed of travel also were significant. This loading is consistent with the cycling experiences of residents of Calabar where only 27.5% admitted having high experience.

4.1.8. Neighbourhood with pleasant view and security:

Questions that emphasised pleasant and secured neighbourhoods loaded highly among the rotated factors. This presents future safety challenges that cyclists are likely to face if crime levels are not reduced to minimum.

4.1.9. Economic and environmental cost:

Economic cost of transport and the general awareness of the impacts of cycling also loaded highly. The current economic recession with accompanying high cost of living remain a motivation for high volume of cycling if basic infrastructure is provided. The public is also aware of the impacts of motorized traffic on the urban environment and thus seem willing to make sacrifices for reduced emissions.

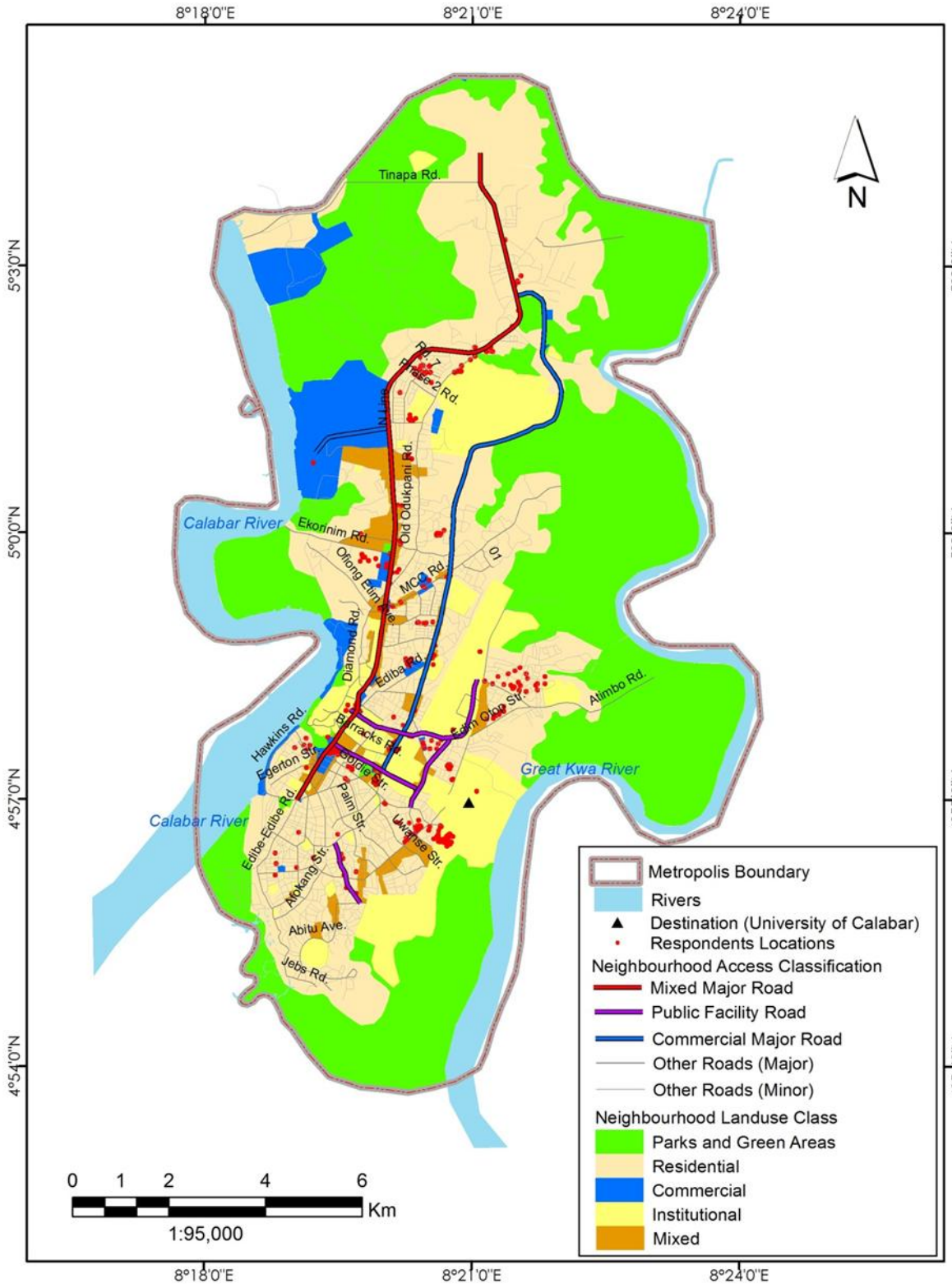

Figure 5. Land use, neighbourhood characteristics, major transport arteries and location of respondents in Calabar metropolis

4.1.10. Long trip length:

Specific long trip lengths loaded highly slightly above the cut-off. In view of this, an assessment of the percentage of respondents in five different scenarios was carried out. These scenarios include location within 1, 2, 3, 4 and 5km radius of the University of Calabar where data was collected (Figure 6). For instance, 13.5% commute <1km to school; 15.8% commute 1-2km; 14.5% commute 2-3km; 14% commute 3-4km; 5.3% commute 4-5km; while 37% commute >5km to school/work. The implication of this data is less than a quarter of the respondents live close to the university, at least 1-2km which is the likely limits of work/school related trips.

4.2. Conclusion and recommendations

Findings of this study revealed high enthusiasm of young people (less than 25 years of age) to walking, cycling and vehicle transportation in the study area. Furthermore, about 3.6% of study participants acknowledged having personal bikes, 8.8% have access to a bicycle from family/friend while 75.6% do not have access to a bicycle at all. The potential for cycling in the university was revealed as 15.7% of study participants are most likely to undertake unconditional utilitarian cycling to school. However, 57.1% indicate that they will ride given certain conditions of safety, infrastructure and weather, 19.9% are very unlikely to ride, while 7.4% remain undecided. Exploratory Factor Analysis (EPA) on 33 items with orthogonal rotation (varimax) obtained 10 components in the data having eigen values over Kaiser's criterion of 1 and in combination explained 58.9% of the variance. These components formed the basis for extraction and naming of factors that that are fundamental to cycling promotion in the study area. In their order of importance, these factors included: commercial major roads, residential neighbourhoods, mixed neighbourhood, cycling factors, trip purpose, ridership frequency, neighbourhood with pleasant view and security, economic and environmental cost, and long trip length.

On the basis of the research findings we can suggest some additional policy recommendations for the University management as well as the Calabar metropolitan authority. Proper orientation of land uses in the campuses, giving special attention in terms of cycling infrastructure to cyclists and pedestrian rather than motorists. This also means a clear preference for direct bike itineraries and the installation of safe parking lots in and around the campuses. Other cycling-related infrastructure such as public bathrooms in strategic places can enhance cycling in the University. Cycling should be promoted as sustainable and healthy mode of transport through university media, and recommended as an access mode to reach many university facilities.

In terms of the city authority, enabling legislation should be developed to make cycling lane as part of every major road infrastructure. Street should be redesigned to allow for good crossing, directness, continuity, visual interest and amenity, security and so on to enhance utilitarian cycling in the city. Relevant bicycle infrastructures including parking places, bicycle crossing lights, signage and so on. The present smart city project of the metropolis should infuse non-motorised transport options to promote community living. Cycling should be promoted as sustainable and healthy mode of transport capable of reducing the impacts of climate change.

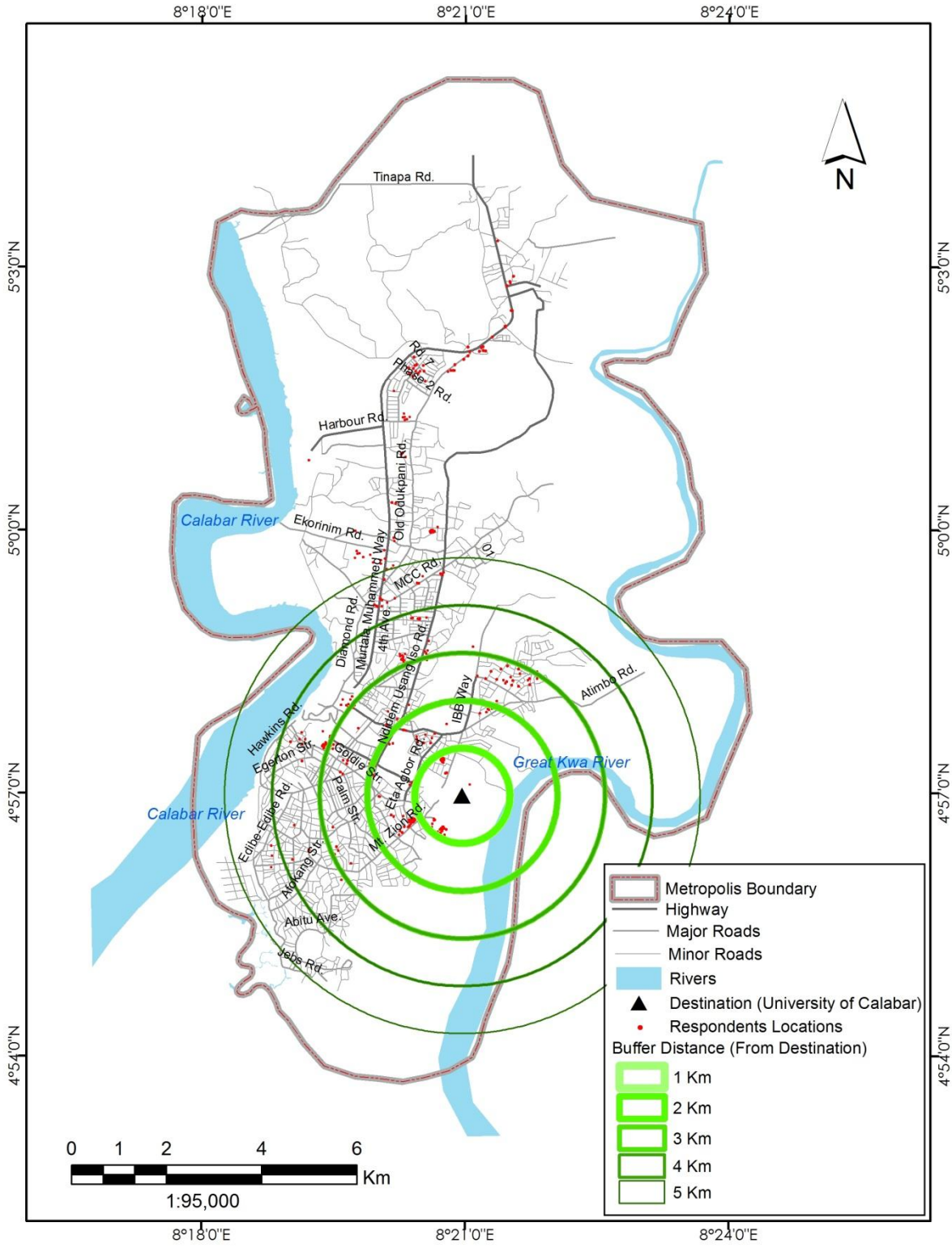

Figure 6. University of Calabar as centroid, location of respondents and 5 scenarios of trip length in Calabar metropolis

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