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AN EVALUATION OF THE RELATIONSHIP BETWEEN SPATIAL FORM AND TRANSPORT MODE IN ELIM, SOUTH AFRICA

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Abstract:
The location of activities and the need for interactions create a demand for transport. The mode of transport choices for traveling to commercial centers has always been varied. However, private car use has been the most frequently used mode of transport. As a case study, this study explores how retail trade has influenced transport mode choice in the Elim commercial area in Makhado Local Municipality, South Africa. A mixed method approach was adopted using secondary data and a questionnaire survey to acquire data amongst customers in the Elim commercial area. A Cronbach Alpha test using the survey data was done to check the data's reliability and internal consistency achieving a Cronbach α = 0.903, which indicates that the survey data is reliable. The results show that the retail trade area increased in minibus taxis and local people walking to the node where the retail trade is located. The study concluded that the land-use structure in the local area significantly influenced the transportation mode.

Keywords: land-use planning, commercial centers, retail center, transportation planning, spatial planning
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INTRODUCTION

Competition between retail centers is influenced by, amongst other things, the upgrading of intra and inter-city transportation systems that allow consumers to travel to faraway business or retail trade areas options (Singh & Sahay, 2012). Decision-making on travel mode choice is influenced by people's activities and life patterns, generating different and complicated travel demands (Witchayaphong et al., 2020). Bilkova et al. (2016), Michel & Scheiner (2016), and Cervero (2013) contend that land development patterns favor private cars, and Mallqui & Pojani (2017) state that city that is sprawling has a car-oriented population and middle and high-income groups that prolong the usage of private cars. Relocating to rural or less urbanized areas plays a role in households' decision to own cars and the travel distance for work, shopping, and social and leisure trips (De Vos et al., 2020). According to Petruccelli (2016), residents in urban-style settlements (mixed-use) usually only have a car or more than one car per family as they are generally close to most of their trip destinations, including shopping places. Such types of settlements encourage non-motorized trips and the use of public transport.

Compact mixed-use neighborhoods encourage residents to conduct their activities locally and promote greater use of other means of transportation but cars. Residents of dense mixed land use take short trips and mostly use public transport or other means other than private cars for most of their travel. A suitable location for a shopping center with access from customers' places of residence and work attracts shoppers (Kaur, 2013; Markovic et al., 2014; Lucia-Palacios et al., 2016; Wang, 2019; Borusiak et al., 2018). Thus, retail centers' location decisions need thorough validation

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concerning customer attractiveness aspects like accessibility and purchasing power, consequences of road traffic, and related accident hazards. They attract and generate high pedestrian and car traffic from the local areas and other neighborhoods (Raicu et al., 2016).

Kushwaha et al. (2017) maintain that consumers prefer to visit retail centers near their residences or workplaces and usually avoid traveling long distances. The location of retail centers outside residential and city centers increases the travel distance of shopping trips and private car usage, underlining that the spatial context at the place of residence has the most significant effect on shopping trip distances. Good quality and quantity of retail centers in a neighborhood are linked to markedly shorter shopping trips. At the same time, in retail centers with anchor stores, grocery shops are within walking distance from customers' residences, and most individuals commute long distances to acquire specific goods (Ozuduru & Guldmann, 2013; Kushwaha et al., 2017; Mary et al., 2013). The customers trade convenience with the prices, quality of goods, and availability of parking or entertainment facilities. Road connections allow customers to access retail centers by car and other means.

Hence, the macro-accessibility of retail centers relates to the access road to the shopping center and the centers' nearness to the customer's place of work or residence (Ahmad, 2012). Accessibility of retail centers, according to Sebastian and Purwanegar (2014), can be measured by analyzing the difficulty or ease with which customers reach the place by public transportation. However, according to Lyons and Davidson (2016), accessibility is a multifaceted concept that is difficult to assess and grasp in practice. Raicu et al. (2016) assert that retail centers attract and generate substantial numbers of private cars, light cargo trucks, and pedestrians from local and nearby areas. Private cars are one of the most important modes of transport used on shopping trips, especially for people with modern lifestyles. People drive to large retail centers daily, weekly, or infrequently. Even in areas with high walking and bicycle trips, many people still travel by car when visiting retail centers where goods must be transported from the grocery shops in the center because pedestrians cannot carry as many goods as private cars (Bilkova et al., 2016; Etminani-Ghasrodashti & Ardeshir, 2015); Cervero, 2013).

Nonetheless, the availability of public transport close to retail centers impacts the choice of a retail center, promotes the inflow of customers, and affords customers the convenience of surmounting the distance problem related to time and space. The advantage of distance decay in travel activities is that the highest travels are generally observed amongst land uses nearby. Residents mostly cite short distances to public transport, shopping places, and workplace as a critical reason for choosing their residential area (Kunc et al., 2016; Berdegue et al., 2019; Kroesen, 2019; Reichert & Holz-Rau, 2018). Retail centers attract more pedestrians as shopping trips begin and end with a short walking trip. Pedestrians would likely walk longer distances with wider sidewalks and better streets with excellent connectivity since they trade between route distance and quality. A safe environment, paths, sidewalks and streets, density, and continuity encourage people to walk (Mitra, 2013; Ton et al., 2019; Wang et al., 2019).

Therefore, As a case study, this study explores how retail trade has influenced transport mode choice in the Elim commercial area in Makhado Local Municipality, South Africa. The study is significant because a few studies examine the relationship between transportation and land use in locations outside the main cities in South Africa. Most studies focus on the country's leading cities, adjacent townships, and suburbs (Strydom, 2013; Mashaba & Wiese, 2016; Makgopa, 2016; Mason et al., 2019). Hence, they need to pay more attention to the medium and small towns in the outer areas regardless of their role in national economic development and counter-urbanization. This study remedies the deficiency by extending the existing literature on the relationship between transportation and land use in medium and small South African towns. It also contributes by

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adding an African perspective to the growing literature on the link between land use and transport. The study's limitation is that it analyzed the relationship between transportation and land use in terms of travel mode choice focusing only on retail centers.

METHODS

The research method used in this study is mixed. Secondary data was collected from journal articles, and primary data using a questionnaire survey focused on participants between the ages of 20 and 60 who were active visitors to the Elim commercial area. The secondary data was used to understand the current study's research problem and position the present study within the context of existing literature internationally. The study hypothesizes that Elim commercial center is located in an easily accessible location that generates traffic and pedestrians who are customers in the center and adjacent area (used for work and shopping purposes). It significantly impacts the customer's choice of transport mode because of its built environment structure. The study area Elim is located within Makhado local municipality in the province of Limpopo at latitude 23°09'28 "S and30°03'23 "E longitude, and its boundaries are aligned with the municipality's planning and administrative boundary.

Makhado Municipality has a population of 416 728 people and is 7 623.6 square kilometers in size, and Elim has a population of 16,538 people and is about 10.6 square kilometers in extent. The population is 4% of the entire municipality, with a density of 1160 persons/km2 (Makhado Municipality, 2018). The survey took place in 2019 with a sample of 391 customers. The sample size fulfills the sample's requirement suitable for a population the size of the study area (16,538 people) (Krejcie & Morgan, 1970). The participants were proficient in English and voluntarily participated. They were asked permission to complete a structured questionnaire in the researcher's presence and returned it after completion at the same place. The first section of the questionnaire focused on getting data about the respondents' demographic information, and the second part was comprised of questions on the transport modes that the participants used for shopping trips.

The customers were asked about their travel mode to the commercial area and expressed their opinions using the questionnaire's statements. Respondents were required to indicate if they use the transport mode, 1 = always, 2 = Often, 3 = sometimes, or 4 = Never. A weighting score was given to each answer for data analysis purposes. Data from the survey were presented and analyzed using descriptive statistical methods using frequencies and percentages. A Cronbach alpha coefficient technique was used to test the reliability of the survey data.

The study's primary purpose was to examine the impact of the Elim commercial area in Makhado Local Municipality on the transport mode choice of people who visit the site. The variables that are essential in examining the impact of the commercial site are location, traffic, pedestrians, and public transport. Von Thunen's regional land-use model, Hoyt's (1939) transport corridors (transport axes), and Harris and Ullman's (1945) multiple nuclei model will be used to guide the analysis of the variables. Von Thunen's regional land-use model purports that agricultural land use is patterned in concentric circles around a market that uses all the excess produce that must be transported. This transportation cost plays a crucial role in determining land uses. Hoyt's (1939) transport corridors (transport axes) and Harris and Ullman's (1945) multiple nuclei both consider the influence of motorization on the spatial formation of settlements ((Cavero, 2013; Mallqui & Pojani, 2017).

The survey results indicated that most participants were male (51%), and most were between the ages of 31 - 40 (17%). The highest number of women participating was between 31 - 40 at 14%. Males in the age group 51- 60 years recorded the lowest participation rate at 9%, and for females, the lowest participation rate was amongst the 20 - 30 years at 11%, as depicted in Table 1 below.

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Table 1. Demographic profile of participants' percentages.

Age	Gender				Total	
	Male		Female			
	Number	Percent	Number	Percent	Number	Percent
20 - 30	46	12%	42	11%	88	23%
31 - 40	67	17%	55	14%	122	31%
41 - 50	51	13%	44	11%	95	24%
51 - 60	36	9%	50	13%	86	22%
Total	200	51%	191	49%	391	100%

The highest number (41%) of participants use minibus taxis always, followed by 35% who use private cars occasionally and 33% who always use private cars. The second-highest numbers are 30% who never walk, 30% who use minibus taxis often, and 25% who always walk to the center. The lowest numbers are 8% who never use minibus taxis, 15% who often use a private car, and 17 % who never use a private car to the commercial area.

Table 2. Mode of transport usage

Mode of transport	Scale							
	1= Always		2 = Often		3= Sometimes		4= Never	
	N	%	N	%	N	%	N	%
Minibus taxi	162	41	117	30	82	21	30	8
Private Car	130	33	58	15	138	35	65	17
Walk	99	25	85	22	89	23	118	30

A Cronbach Alpha test using the survey data achieved a Cronbach α = 0.903. An acceptable value of a Cronbach Alpha test typically ranges from 0.70 to 0.95. Therefore, the value attained indicates that the survey data has good reliability or internal consistency.

RESULT AND DISCUSSION

The findings show that more males, especially those in the age group 31 - 40, visited the commercial area, which indicates that a retail site is a shopping place and a place of employment as those in this age group are in the workforce. The high number is associated with a commercial center being a place for shopping and work. A high percentage (41%) of respondents indicated minibus taxis as their mode of transport, which is linked to the existence of a well-established minibus taxi rank in the commercial area that provides public transportation to nearby areas outside of the study area and that only 25% of residents own cars. The second-highest percentage of respondents indicated that they use private cars (35%) associated with the parking space in the center. Land use encourages car owners to drive to commercial areas because there is a safe place to park their cars.

The situation above demonstrates the relationship between the taxi rank and the parking area as land uses to the transportation mode customers in this area use. The findings are consistent with Bilkova et al. (2016) and Michel & Scheiner (2016). They concluded that land development patterns related to commercial areas continue to favor the use of motorcars which in this study is public transport and private cars. As indicated in the first paragraph, the results also show that those aged 35 - 54, mostly in full-time employment, have dependent children. They prefer public

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transport and private cars to travel to the commercial area with their families. Again, most people use minibusses and private cars, which is also likely due to transporting groceries and more significant amounts of goods by minibusses and cars, resulting in a few people walking to the commercial area.

The high number of people using minibus taxis can be linked to the fact that more people buy groceries from the retail Centre than those who buy big furniture and other goods that require them to hire delivery vans (bakkies) for transportation. The results are not congruent with Raicu et al. (2016) asset that commercial areas also attract and generate a substantial number of pedestrians from local and nearby areas but correspond to the author's assertion that retail centers attract and generate significant numbers of private cars and light cargo trucks. The results correspond to Bilkova et al. (2016) and Etminani-Ghasrodashti & Ardeshiri (2015), who claim that people with modern lifestyles frequently use private cars in commercial areas. They reveal that Elim residents also link owning a car and driving to the retail center as part of a modern lifestyle though they reside in a rural or peri-urban setting. They also correspond with De Vos et al., 2020 who argue that residents of suburban areas with low density and diversity usually use local public transport and private cars. The lowest number of participants (25%) walk to the center, representing those from a rural setting with gravel roads (without tarmac) and low-income areas who do not own cars and cannot afford to pay for public transportation.

This way, the trip's population is positively associated with walking instead of minibus taxis or private cars. This group mostly comes from the western side of Elim, a rural village with no minibus taxi routes. The situation aligns with Cervero (2013, p. 20), who states that "walking is the only form of transport for the very poor. Many are "captive walkers," who cannot afford an alternative." Those who use private cars and minibusses originate from the urban residential zone in the study area and the peri-urban area west of the commercial area and have access to roads like those in urban areas. The street connectivity in rural and peri-urban areas of Elim encourages those who reside within walking distance (typically not more than 2km) to walk to the center. The results are like that of Wang et al. (2019); however, the findings are not in harmony with Reichert & Holz-Rau (2018), who concluded that high-density mixed-use encourages walking.

In this study, the aspect that carries more weight is street connectivity, accessibility, and good-quality roads. From a theoretical perspective, land uses in Elim emanate from the Hoyt (1939) sector model, to which the apartheid city model bears a resemblance. In addition, the post-apartheid era transport corridors (transport axes) and the Harris and Ullman (1945) multiple nuclei models influenced South African polycentric cities. The models continue to influence Elim settlements' spatial formation and support minibus taxis and cars more than walking to the center within these settlements.

CONCLUSION

The analysis in this study has illustrated that Elim's land-use structure significantly influences the residents' choice of transportation mode, meaning that the spatial factors determine the mode of transport in that area. The introduction of the Elim commercial area and its taxi rank encourage the use of minibus taxis instead of residents walking to the commercial center. The research results should be viewed within the context of the limitations of the study's research. The limitations include that the findings are based on a limited sample of participants drawn from a commercial area in Limpopo Province, South Africa, which is rural and may not be applicable in other parts of the country, especially in urban areas. However, the results can be generalized in similar commercial centers and settlements with related conditions. Furthermore, this research focused on a single commercial site; henceforth, studies should be extended to more than one

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center and location. Future research should also be conducted on a larger sample, including other aspects such as diversity in mixed residential and commercial buildings near the commercial areas.

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