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CONTENTS

1.	Assessment of the Influence of Kitchen Space Quality on the Cooking and Dietary Habits of University Students <i>Adelabu, J.K., 2Amole, D. and 3Suleiman, A. R.</i>	-	-	1-13
2.	Assessment of Building Decay in Intermediate Quarters in Minna, Niger State, Nigeria <i>Abdulsalam Biliaminu</i>	-	-	14-29
3.	Analysis of the Spatial Distribution of Plateau State Water Board Water Production Facilities in Plateau State, Nigeria <i>Godep Joseph Jurbe and Marcus N. Danjuma</i>	-	-	30-50
4.	Spot Speed Study of Vehicular Traffic on Highways in Benue and Nasarawa States, Nigeria <i>Vesta Memshima Udoo, Timothy Terver Gyuse, Anongu Lyam and Timothy Anchuvur</i>	-	-	51-60
5.	Role of Women in Agricultural Activities in Mangu Halle, Plateau State, Nigeria <i>Wuyep Solomon Zitta, Daloeng H.M. and Williams James Jefferson</i>	-	-	61-72
6.	Assessment of Hypertensive Disorder Among Pregnant Women in Abuja Municipal Area Council, Federal Capital Territory Abuja, Nigeria <i>Abubakar, Mahmud</i>	-	-	73-90
7.	Assessment of Optimal Location for Wind Farm Development in Nasarawa State, Nigeria <i>Usman Salihu Lay, Nweke Anita Odionyenfe, Owoicho Christopher and Rikko, Laraba Samuel</i>	-	-	91-100
8.	Impact of Coal Mining on Soil Properties in Maiganga, Akko Local Government Area, Gombe State, Nigeria <i>Buba Samaila, Idoma Kim and Jennifer H. Hammadu</i>	-	-	101-112
9.	Malaria Vulnerability Mapping of Ilorin-South, Kwara State, Nigeria <i>Babalola Ayo, Daniel Brimmo, Idrees Oludare M, Modibbo M and Abdulraheem Maimuna Orire</i>	-	-	113-127
10.	Assessment of the Potentials of Municipal Solid Waste Re-use and Recycling as a Management Strategy of Wealth Creation in Lokoja, Kogi State, Nigeria <i>Chunwate B. T, Adem Samuel and J.J Kunda</i>	-	-	128-142
11.	Temporal Review of the Climate Change Impacts and Adaptations of West African Drylands Agriculture: A Case Study of Mali <i>Ahmed Abubakar, Jibrin Gambo, Siriki Fané and Usman Salihu Lay</i>	-	-	143-159

Contents

12	Determinants of the Spatial Expansion of Mpape Urban, Federal Capital Territory Abuja, Nigeria <i>Dr. Felix Kwaghtagher Kwaghssende and Kolawole Saheed Eniola</i>	-	160 - 168
13.	Socio-Economic Impacts of Floods in Yola North Local Government Area, Adamawa State, Nigeria <i>Godwin A. Songu, Richard S. Thlakma, Nenpanmun T. Molwus, Salau Wahab</i>	169 - 179	
14.	Assessment of Health Risk of Effluent from Tanning Industries in Naraguta Jos, Plateau State, Nigeria <i>Maleka David Dando and Ishaku J. Dibal</i>	-	180 - 193
15.	Detecting Subtle Land Use Land Cover Changes at Small-Scale Using Landsat 8 Imagery in Ilorin East Local Government Area, Kwara State, Nigeria <i>Mohammed O. Idrees, Ayo Babalola, Dahir M. Omar, Hossein A. Ahmadi, Abdulazeez O. Abdulyekeen, Ruth K. Aniyikaye and Olatilewa F. Ojulari</i>	-	194 - 202
16.	Evaluation of On-Street Parking on Traffic Flow in Ilorin Central Business District, Ilorin, Nigeria <i>Suleiman A. R, Raheem W. M, Ola A. B, Raheem W. A, Jimoh M. Y and Oladimeji S. B</i>	-	203 - 215

Evaluation of On-Street Parking on Traffic Flow in Ilorin Central Business District, Ilorin, Nigeria

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Abstract

This Study evaluates on-street parking in Ilorin Central Business District (CBD), Ilorin, Kwara State. It examined the on-street vehicular parking mode and its impact on flow of traffic in the CBD. The study adopted a survey research design using primary and secondary data sources. A sample frame of 4,543 respondents was determined through parking volumetric count that was conducted between 7:00am to 7:00pm. Questionnaire was administered to 354 motorists who parked their vehicles on the street, using accidental sampling technique to elicit information on parking characteristics. All the six major roadways that criss-crossed the CBD were selected for the study. Descriptive statistics was used to analyse the data while vehicle to capacity ratio was used to evaluate the impact of on-street parking on traffic flow. The study revealed that

57.9% of the respondents' vehicles were parked on the street for the purpose of business and work. Further finding indicated that 61.4% of the motorists parked on the road curb because of inadequate or lack of off-street parking facilities in the city's CBD. Traffic flow was stable in the four major roadways selected, with the exception of Ibrahim Taiwo Road where traffic flow was not stable and queues developed rapidly, as this contributed to traffic congestion along the road corridor. The paper recommends among others the provision of adequate and designated on-street and off-street parking facilities, regulation of parking by introducing park and pay to discourage on-street parking.

Keywords: Traffic flow, On-street parking, Central Business District, Ilorin.

1.0 INTRODUCTION

Parking is an integral component of the transport system, as it plays a crucial role in the management of traffic and congestion mitigation. It is a common phenomenon that vehicles traveling on highways are parked at some point either for a relatively short time or a much longer time, depending on the reason for parking. Provision for parking facilities is therefore, an essential element of the road transportation development especially in urban centres. The increasing population and expanding urban centres have been accompanied by increasing vehicle ownership rate and increasing demand for movement of people and goods which has resulted into increased use of automobiles for transport (Osoba, 2012; Vasconcelos & Farias, 2017).

In the urban areas, automobiles are parked for more than 95% of their usage time, and consume close to half of the land area of cities (Pamar, Das & Dave, 2020). Vehicles are parked before the occupants undertake any activity elsewhere. However, frequent and indiscriminate parking of vehicles requires valuable space and an unplanned distribution of parking space negatively impact on the traffic flow. Thus, the significance of car parks in local, strategic planning and policy are essential components of consideration for any trip

(Bates & Bradley, 1986; Biswas, ., Chandra & Ghosh, 2017). Parking facility generally is a responsibility of government and is thus, defined by local needs. Municipal governments require minimum parking spaces to ensure that an adequate number of lots are provided for in order to avoid vehicular parking spill-over on to adjacent streets and maintain traffic circulation.

The increasing number of private vehicles ownership and high densities of human activities in and around CBD areas jeopardizes the Central Business Districts (CBD's) advantage, with inadequate public transport facilities, these factors rendered proximity between some land uses unnecessary and most times unsuitable for driving (Jackie & Sculle, 2004; Kasraian, Maat, & van Wee, 2019). For many years, the role of parking policy in most developed countries was to accommodate the automobile commuter by providing convenient spaces to park. As cities grew and became more complex, decision makers favoured removal of on-street parking from major arterial roads. It has been recognized in the literature that the amount and location of parking can influence the condition of traffic on roads in the city, the form and functioning of the area and the environmental quality of the city (Stubbs, 2002).

In most CBDs of Nigeria, parking is one of the most noticeable problems as there are few designated parking spaces which have already proved insufficient. In Lagos for instance, Ogunsanya, Vandu-Chikolo and Sumaila (2004), observed that illegal parking alone account for 30 percent of the cause of traffic delay. Unauthorized and indiscriminate parking along streets within the urban core is a serious impediment to smooth urban movement and is indicative of lack of adequate attention to this aspect of transportation. Ilorin is one of the major cities in Nigeria. The city is remarkably growing in physical and socio-economic dimension (Ahmed, 2015). However, the city is confronted with traffic problems which necessitated the study to be carried out in Ilorin CBD to examine the impact of on-street parking on traffic.

The study of parking has a long history in the literature. Weant and Levinson (1990), states that parking contributes to the appearance of city and suburbs; affects traffic congestion and traffic operations; and equally influences the choice of mode and route of travel which also affects the viability and competitive posture of commercial areas. Since cities are characterised with different land use activities and patterns of circulation are partly a function of land use activities and their spatial distribution, therefore, efficiency of this circulation depends upon existing transportation system which parking facilities are a major component (Morimoto, 2012). Osoba (2012), is of the view that road transport operation is a circulatory system that must be a continuous process and any infringement at any point along the line will definitely affect the whole system and hinder its effectiveness. Therefore, parking facilities are essential in order to allow the flow of traffic. Since, parking challenges are no longer confined to the city centres, the challenges now extend throughout the urban region.

According to Obot (2007), in Nigeria, like elsewhere, where cars are one of the

dominant modes of transportation, urban circulation is one of the most obvious problems and parking seems to be an overlooked element in transportation development. Several studies have shown that improvement in the living standards of people as a result of wage increase contributes almost as much as the growth of cities to contemporary urban traffic condition in Nigeria (Tanimowo & Atolagbe, 2006).

Akhuewu (2010) opines that for a city to function as a system, transportation must be efficient and reliable to facilitate, not only intercity movement of people and their activities, but also encourage intra-city movements within the city. These movements are from point of origin to the point of destination. On-street parking refers to the parking space made available along the curb or shoulder of a street or road that are designed to accommodate vehicle.

The use of on-street parking affects the traffic movement in three ways: it reduces a streets' capacity; it reduces safety, and increases service conflict (Richard & David, 2007). On-street parking causes safety and congestion problems by blocking one or two traffic lanes, reducing visibility, insecurity and forcing pedestrians to walk on the road if no proper footpaths are provided and it also obstructs access for emergency services thereby resulting in accidents and affecting traffic movement (Rye, 2010). There are two types of on-street parking: official and non-official parking. The official on-street parking includes bank car parks, administrative car parks, office car parks, and recreational car parks and media car park while non-official on street parking is referred to as kerbs.

Findings by Olayiwola, Olaseni and Fashina (2014), revealed a haphazard land use pattern in Ikeja CBD resulting into traffic and transportation bottleneck, vehicular conflict and avoidable traffic congestion, longer travel time and low productivity. There is need for a review of CBD development guide as well as effective traffic management through enforcement and compliance.

Litman (2017), has also recommended an integrated parking plan which should be adjusted to reflect the needs of a particular situation. The steps include defining the geographic scope of analysis such as the site, street, district/neighbourhood and regional scale. It is imperative to carefully define parking problems and planning to achieve coordination with a community's overall strategic vision and development of a comprehensive evaluation framework.

According to Nahar, Chakma, Uddin and Das (2018), in a comparative study of designated parking bay and non-designated place of parking, it was discovered that illegal on-street parking contributed to the traffic jam in the city centre of Rajshahi and this in turn further reduced the level of service of the roads.

2.0 MATERIALS AND METHODS

This study adopts a simple descriptive research design to generate and analyse relevant data in the CBD of Ilorin. The primary data source includes personal observation which was done to determine the road pattern and their characteristics such as length of the road.

width of carriageway, central and paved shoulder. Questionnaire was administered on the motorists who parked their vehicles on the street. This was necessary to obtain information about trip origin/destination, purpose of trip, frequency, duration and purpose of parking. Lastly, direct observation in the form of traffic volume survey was conducted on the selected major roadways which include; Murtala Mohammed Way, Ibrahim Taiwo Road, Ahmadu Bello way, Sulu Gambari Road, Unity Road and Ajase Ipo Road (Table 1).

Table 1: Characteristics of major roads in Ilorin CBD

Name	No. of lane	Length (km)	Width (m)		paved shoulder	Total
			carriageway	central median		
Murtala Mohammed Way	4	3.86	15	4	4	23
Ibrahim Taiwo Road	4	3.16	10	3	2	15
Ahmadu Bello Way	4	2.67	12	3	3	18
Sulu Gambari Road	4	1.12	12	1.5	2	13.5
Unity Road	4	1.01	10	2	2	14
Ajase Road	4	0.99	14	4	4	22

Source: Author's Field survey, 2021

Sample size and Sampling frame

Formula by fisher *et al* (1998) was used to determine the sample size of the study. From the preliminary survey, an average of 4,543 vehicles were parked for the period of the survey. The sample size was determined using the formula recommended by fisher *et al.* (1998), as follows:

$$n = \frac{Z^2 P (1 - P)}{I^2}$$

Where:

N = Sample size (where population > 10,000)

Z = Normal deviation at the desired confidence interval. In this case it will be taken at 95%, Z value at 95% is 1.96

P = Standard deviation with the desired characteristic of 0.5.

I² = Confidence interval; will be taken to be 5%

Therefore: n = 384 respondents, since the target population is less than 10,000 and formula to find (nf) is used

Where: nf = desired sample size when population is less than 10,000;

n = the desired sample size when population is more than 10,000;

N = the estimate of the population size (4,543 parked in the survey area)

Therefore, a total of 354 respondents constituted the sample size which translates to 7.8% of the total vehicle parked along the six major roadways and their distribution is shown in table 2. Due to the dynamics in the length of vehicular parking in terms of duration, accidental sampling techniques was adopted to administer the questionnaire.

Traffic count was conducted between 7:00 am to 7:00 pm on Monday, Wednesday and Saturday in a week and distribution is shown in table 2.

Table 2: Traffic Volume generation, observed, vehicular parking and Sample size

Roadway	Average Traffic Volume/12hr	Observed average vehicle parked	7.8% of total sample
Murtala Mohammed Way	36,504	1,217	95
Ibrahim Taiwo Road	23,347	778	61
Ahmadu Bello Way	10,483	349	27
Sulu Gambari Road	16,512	550	43
Unity Road	26,591	886	69
Ajase Road	22,896	763	59
Total	136,333	4,543	354

Source: Author's Field Survey, 2021

The method adopted for data analysis is a simple descriptive statistical method. Also, Length of Service (LoS) rating which estimates the road's traffic volume-to-road capacity (v/c) ratio or the average delay experienced by vehicles on the roadway was also adopted to further analyse the impact of on-street parking on the major roadways. Basic definitions are presented in table 3.

Table 3: Level of Service (LoS) for Roadways

LoS	Traffic Flow Characteristics	V/C ratio
A	Free flow; insignificant delays	0.00 - 0.60
B	Stable operation; minimal delays	0.61 - 0.70
C	Stable operation; acceptable delays	0.71 - 0.80
D	Approaching unstable flow; queues develop rapidly but no excessive delays	0.81 - 0.90
E	Unstable operation; significant delays	0.91 - 1.00
F	Forced flow; jammed conditions	>1.00

Source: Author's Field Work, 2021

The Volume-to-Capacity ratio (V/C) measures the level of congestion on a roadway by dividing the volume vehicles per day (VPD) of traffic (existing or future) by the capacity of the roadway. The V/C ratio makes it possible to estimate the relative level of congestion on a segment of roadway. For calculating V/C ratio, the design Capacity is measured by the formula:

$$\text{Design capacity} = (\text{Effective width} / 12) \times 1400.$$

The road capacity in terms of vehicle volume and on-street parking was determine through the volume to capacity ratio.

3.0 RESULTS AND DISCUSSION

Trip Generation and Parking Characteristics

The six roadways that traverse the CBD formed a grid that collect and distributes traffic to and from the CBD. Respondents whose trip originated from Ga-Akanbi/Pipeline/Ga-Imam and Taiwo/Ipata were found to be 9.8% and 7.7% respectively on Murtala Mohammed way. The road traversed and halved the city of Ilorin into north and south. Major human activities are concentrated on this road which includes; banks, post office, police station, shopping complex, railway station and other notable landmarks. These activities attract high traffic from virtually all other districts/neighbourhoods and hence, the need for motorist to park their vehicles. Respondents from Taiwo/Ipata area represents 14.8%, those from Oja-oba/Baboko accounted for 3.3% while motorist from Agric/Sango area constituted 13.1%. It is worthy of note that Ibrahim Taiwo Road is one the busiest roadway, because of the large concentration of commercial activities. The entire stretch of the road from Sulu Emir Road junction to the general hospital round about is a beehive of commercial activities and this necessitated high traffic and parking demand in the area. Ahmadu Bello way is one of the roads in Ilorin that was planned and constructed according to standard, because of its associated road furniture such as lay bay, closed drainage, grass verge, an ample walkaway and central median among others. On this road, on-street parking is lesser as well as traffic generation, reason being that there are numerous administrative buildings such as the government house, state secretariate, police/DSS headquarters, fire service and some pockets of commercial buildings.

Furthermore, along Sulu Gambari/Emir Road, 57.2 % of the respondents were from Taiwo/Ipata, Fate/Tanke/GRA and Unity/Irewode combined. The road is also very strategic as it connects Ahmadu Bello way, Murtala Muhammed way and Ibrahim Taiwo Road to the core area of Ilorin. There are administrative and commercial presence on the road that attracts high traffic and the need for parking. Those activities include: the high court, CBN regional office, general post office, State library and secretariate annex office. A detour from Mohmmad Murtala way is the Unity Road. It serves as a major link between Murtala Muhammed way, Ajase and Ibrahim Taiwo Road. The respondents whose trip

originated from Unity/Irewolede and Taiwo/Ipata accounts for 39.8%. The road exhibits the same characteristics with other major road way already mentioned above in terms of commercial activities that takes place on the road corridor. Despite its short distance, the volume of traffic generated on the road is very high and hence the need for parking space for the motorists. Lastly, the Ajase Ipo is at the end section of the Murtala Mohammed Road which is toward the eastern part of the city.

Table 4: Trip Origin of the Respondents

Town/ District/ Neighbourhood	Major Roadways					
	Murtala Mohammed way (%)	Ibrahim Taiwo Road (%)	Ahmadu Bello Way (%)	Sulu Gambari Road (%)	Unity Road (%)	Ajase Road (%)
Ganmo/Ita- alamu/ Offa garage	9.8	7.7	0	0	6.3	17.8
Fate/Tanke/GRA	11.5	10.3	33.3	14.3	8.3	2.5
Ga-akanbe/ Pipeline / Ga Imam	16.4	12.8	11.1	7.1	10.4	15.7
Agric/ Sango	13.1	15.4	5.6	17.9	4.2	7.9
Unity/ Irewolede/	8.2	7.7	11.1	14.3	22.9	23.7
Asadam/ Geri Alimi	3.3	2.6	0	10.6	14.5	5.3
Taiwo/Ipata	14.8	23	22.2	28.6	16.7	13.2
Adewole/ Oloje/ Pakata/ Ita-amodu	13.1	10.3	11.1	3.6	12.5	10.5
Oja oba/ Babako/ Gambari	3.3	5.1	5.6	0	4.2	0
Outside Ilorin Metro	6.6	5.1	0	3.6	0	3.4
	100	100	100	100	100	100

Source: Author's Field Work, 2021

CBDs are known as activity centres comprising of commercial, administrative and other land uses that attract high influx of people from its surrounding. Figure 2, presents the purpose of trip and reasons while the vehicle owner's parked on the major roadways. Respondents who commute to the CBD do so mainly for the purpose of shopping and work. This accounts for 57.9% and 45.9% respectively on Ajase and Murtala Muhammed way. The same trends occurred on the other four roadways, where 45.9% of the respondents parked their vehicle in order to engaged in shopping activities. This is true because there are different types of goods and services that can be acquired along the road. These road corridors with its commercial activities necessitated 50.8% of the respondents to parked their vehicles on the street because of the proximity to their destination while

24.6% parked street and at the same wait inside their vehicles. In the same vein, 39.5% of the respondents embarked on the trip for purpose of their work or business. Those in this category are mainly the business owners who do not have parking lots in the shopping areas. Along Ibrahim Taiwo, 41.0% of the respondents parked their cars for the purpose of shopping while 30.8% were there for work purposes. This pattern is almost the same in other roadways, with the exception of Ahmadu Bello way. Traffic is minimal on this road, because of the concentration of administrative building as well as the provision for off-street parking within those premises.

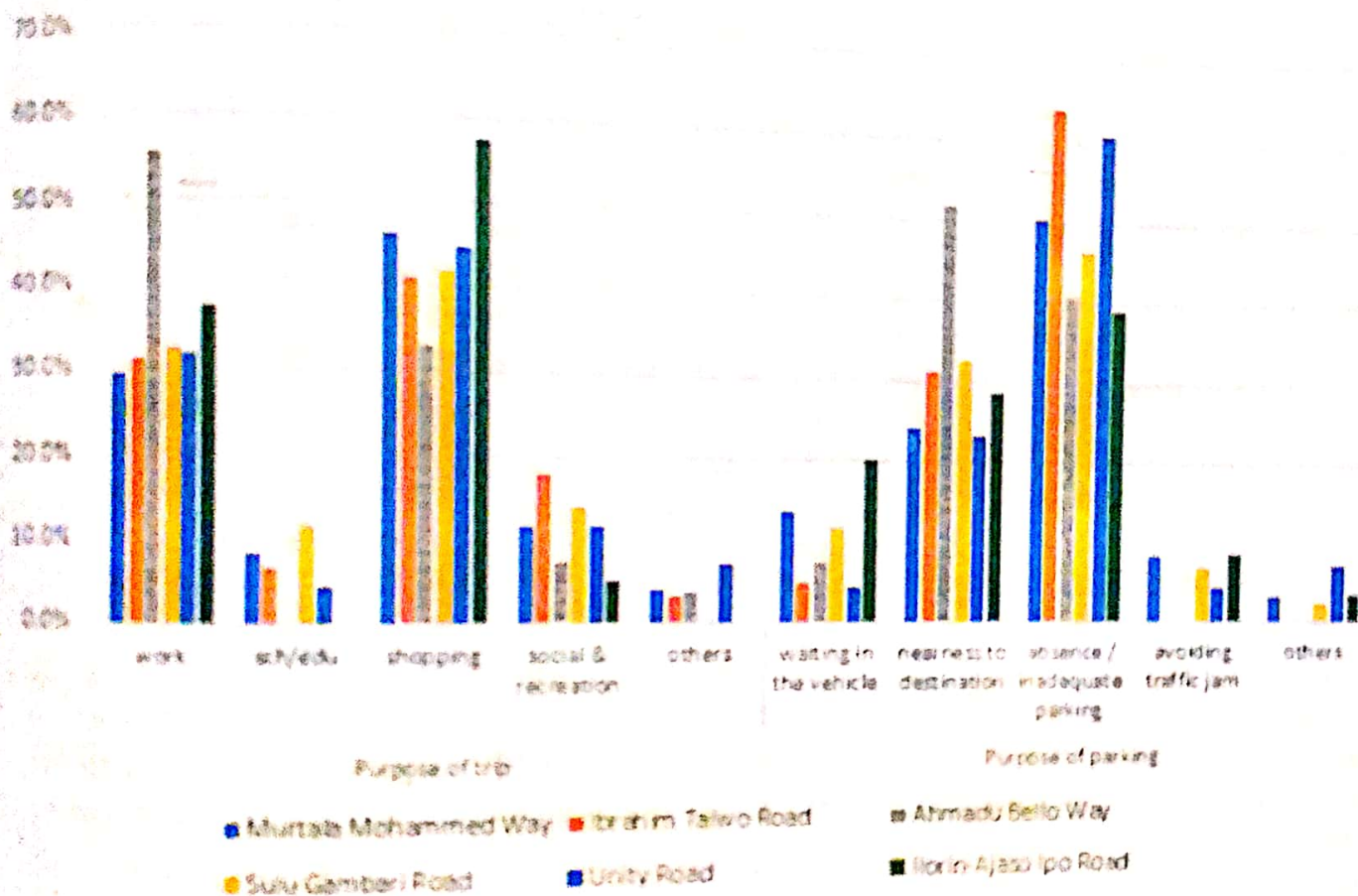


Figure 2: Purpose of Trip and Reason for Parking

Source: Author's Field Survey, 2021

The reasons while motorists parked on the street ranges from convenience, lack or inadequate off-street parking facilities and short time visit among others. On Ibrahim Taiwo Road, 64.1% of the respondents chose to park their vehicles on the street because it is more convenient and for easy manoeuvring when parking and exiting the area. On Unity Road, 61.4% parked on the street because of inadequate or lack of off-street parking facilities. Other notable practice by the motorist on Murtala Mohammed way and Ajase Ipo was that 24.6% and 21.1% respectively of the road users parked and wait inside their vehicles.

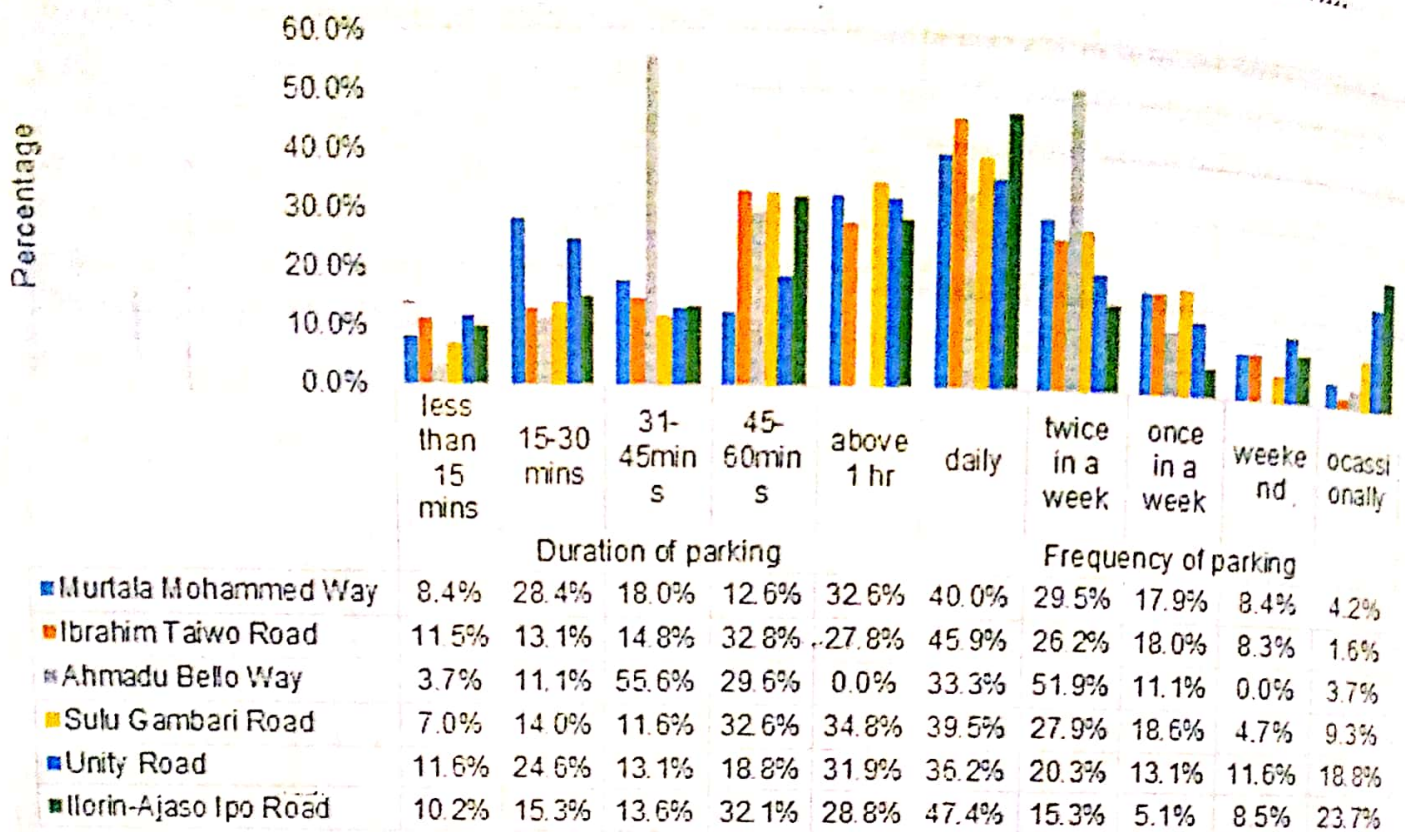


Figure 3: Parking Duration and Frequency

Source: Author's field survey, 2021

Figure 3 presents duration of parking on the major roadways. On street vehicular parking, above 1 hour accounts for the highest percentage. On Ibrahim Taiwo Road, 27.8% of vehicle owners parked for the period of above 1 hour while vehicles parked on Murtala Mohammed Road accounts for 32.6% with the exception of Ahmadu Bello way where parking duration of between 31-45mins represents 55.6%, this was because vehicles owners who parked for a longer time have access to off-street parking facilities. It should be noted that parking has been a long-standing problem in many urban centres; this has been due to the inadequate or absence of clearly designated areas for vehicular parking in the CBDs. A long time on-street parking is predominant in Ilorin CBD as discussed previously (figure 2). Frequency of parking in the CBD was expected to be high due its busy nature. Those who park their vehicles on daily basis accounted for the highest percentage. For instance, on Ibrahim Taiwo Road, 45.9%. of the respondents parked along the road on daily basis. Those who parked twice in a week constituted 51.9% on Ahmadu Bello way, the least were those who visits the CBD occasionally and this was mainly on Ibrahim Taiwo Road (1.6%). Further finding reveals that respondents who parked their vehicles daily are the operators of commercial vehicles and those that have their business premises and offices located in the CBD.

Impact of On-street Parking on Volume to Capacity Ratio

Table 5 presents the road characteristics in relation to their width and passenger car unit

(PCU). On the Murtala Mohammed way, the volume to capacity width of on-street parking was 0.67 and the corresponding LoS is B which imply that flow of traffic is stable flow of traffic. However, without parking on road, the delay is insignificant on the

Table 5: Volume to Capacity ratio of road with and without on-street parking in Ilorin CBD.

Roadway	Carriageway width (m)	Capacity (PCU/hr)	Service volume (PCU/hr)	V/C ratio	LOS	
Murtala Mohammed Way	with on-street parking	13	3,640	2,433	0.67	B
	without on-street parking	15	4200		0.58	A
Ibrahim Taiwo Road	with on-street parking	6.5	1820	1556	0.85	D
	without on-street parking	10	2800		0.56	A
Ahmadu Bello Way	with on-street parking	14	3920	699	0.18	A
	without on-street parking	14	3920		0.18	A
Sulu Gambari Road	with on-street parking	8	2240	1101	0.49	A
	without on-street parking	10	2800		0.39	A
Unity Road	with on-street parking	8	2240	1772	0.79	C
	without on-street parking	10	2800		0.68	B
Ajaso Road	with on-street parking	14	4800	1526	0.32	A
	without on-street parking	14	4800		0.32	A

Source: Author's field survey, 2021

Street parking on Ibrahim Taiwo Road has a decreased width from 10m of the carriageway to 6.5m. The v/c ratio is 0.85 which is class D of the LoS and it means that flow of traffic is unstable and queues developed rapidly but no excessive delays as compared with 0.56 v/c without street parking. Volume of service on Murtala Mohammed way was 3,640 as against the service volume of 2,433 PCU/hr and a corresponding v/c of 0.67 with on-street parking. Traffic flow is stable with insignificant delays. On Unity Road, the v/c was 0.79 with vehicles parked on the road as compared to 0.68 v/c, flow of traffic is stable with delays that are also minimal. There was a similarity in the traffic flow rate of Sulu Gambari/Emir Road and Ajase road with v/c of 0.49 and 0.32 respectively. Despite on-street parking on these roads, traffic flow rate is stable with insignificant delays. However, the situation was different on Ahmadu Bello way where the volume of service was 699 PCU/hr which is far below the road design capacity of 3,920 PCU/hr and this amounts to 0.18 v/c. In addition to low traffic volume, the road has an ample of clearance of space for on-street parking. The traffic flow of vehicles on the six major roadways in Ilorin CBD are

stable with minimal delay of vehicular traffic movement, this is in line with the findings of Das & Keense (2015) and Nahar, Chakma, Uddin, & Das (2018).

4.0 CONCLUSION AND RECOMMENDATIONS

The study has appraised the menace of parking particularly, the on-street parking and its effect on traffic flow in Ilorin CBD. The study revealed that curb parking is extensible in the area due to the land use pattern and inadequate parking spaces/facilities. The study area is an intervening site within Ilorin city and by extension the entire state where commercial activities generate a lot of vehicular and pedestrian traffic. This necessitated the demand for parking spaces and motorists often park their vehicles on the road with the resultant problems of traffic congestion.

However, to allow easy vehicular movement, Ilorin Local Governments in conjunction with the State government and Local Planning Authorities should specify and enforce the provision of parking space in any structure (Building) before approval, while all old buildings along the road in the CBD should be upgraded to accommodate adequate parking space. This will reduce the current situation of traffic congestion and also forestall future occurrences. There is the need for the provision of mass transit, public enlightenment, construction of lay-by at some designated points. Some regulatory measures such as pricing, and improvement in traffic management system, among others should be taken to control illegal on-street parking.

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CONTENTS

1.	Assessment of the Influence of Kitchen Space Quality on the Cooking and Dietary Habits of University Students <i>Adelabu, J.K., Amole, D. and Suleiman, A. R.</i>	1-13
2.	Assessment of Building Decay in Intermediate Quarters in Minna, Niger State, Nigeria <i>Abdulsalam Biliaminu</i>	14-29
3.	Analysis of the Spatial Distribution of Plateau State Water Board Water Production Facilities in Plateau State, Nigeria <i>Godep Joseph Jurbe and Marcus N. Danjuma</i>	30-50
4.	Spot Speed Study of Vehicular Traffic on Highways in Benue and Nasarawa States, Nigeria <i>Vesta Memshima Udoo, Timothy Terver Gyuse, Anongu Lyam and Timothy Anchuvur</i>	51-60
5.	Role of Women in Agricultural Activities in Mangu Halle, Plateau State, Nigeria <i>Wuyep Solomon Zitta, Daloeng H.M. and Williams James Jefferson</i>	61-72
6.	Assessment of Hypertensive Disorder Among Pregnant Women in Abuja Municipal Area Council, Federal Capital Territory Abuja, Nigeria <i>Abubakar, Mahmud</i>	73-90
7.	Assessment of Optimal Location for Wind Farm Development in Nasarawa State, Nigeria <i>Usman Salihu Lay, Nweke Anita Odionyenfe, Owoicho Christopher and Rikko, Laraba Samuel</i>	91-100
8.	Impact of Coal Mining on Soil Properties in Maiganga, Akko Local Government Area, Gombe State, Nigeria <i>Buba Samaila, Idoma Kim and Jennifer H. Hammadu</i>	101-112
9.	Malaria Vulnerability Mapping of Ilorin-South, Kwara State, Nigeria <i>Babalola Ayo, Daniel Brimmo, Idrees Oludare M, Modibbo M and Abdulraheem Maimuna Orire</i>	113-127
10.	Assessment of the Potentials of Municipal Solid Waste Re-use and Recycling as a Management Strategy of Wealth Creation in Lokoja, Kogi State, Nigeria <i>Chunwate B. T, Ademue Samuel and J.J.Kunda</i>	128-142
11.	Temporal Review of the Climate Change Impacts and Adaptations of West African Drylands Agriculture: A Case Study of Mali <i>Ahmed Abubakar, Jibrin Gambo, Siriki Fané and Usman Salihu Lay</i>	143-159
12.	Determinants of the Spatial Expansion of Mpape Urban, Federal Capital Territory Abuja, Nigeria <i>Dr. Felix Kwaghtagher Kwaghsende and Kolawole Saheed Eniola</i>	160-168
13.	Socio-Economic Impacts of Floods in Yola North Local Government Area, Adamawa State, Nigeria <i>Godwin A. Songu, Richard S. Thlakma, Nenpanmun T. Molwus, Salau Wahab</i>	169-179
14.	Assessment of Health Risk of Effluent from Tanning Industries in Naraguta Jos, Plateau State, Nigeria <i>Maleka David Dando and Ishaku J. Dibal</i>	180-193
15.	Detecting Subtle Land Use Land Cover Changes at Small-Scale Using Landsat 8 Imagery in Ilorin East Local Government Area, Kwara State, Nigeria <i>Mohammed O. Idrees, Ayo Babalola, Dahir M. Omar, Hossein A. Ahmadu, Abdulazeez O. Abdulyekeen, Ruth K. Aniyikaye and Olatilewa F. Ojulari</i>	194-202
16.	Evaluation of On-Street Parking on Traffic Flow in Ilorin Central Business District, Ilorin, Nigeria <i>Suleiman A. R, Raheem W. M, Ola A. B, Raheem W. A, Jimoh M. Y and Oladimeji S. B</i>	203-215

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