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Transportation Research Procedia 00 (2018) 000–000

Transportation Research Procedia

www.elsevier.com/locate/procedia

World Conference on Transport Research - WCTR 2019 Mumbai 26-31 May 2019

Impact of Urban Sprawl on Travel Demand for Public Transport, Private Transport and Walking

Khalil Ahmad Kakar[a*], C.S.R.K Prasad[b]

[a] *Transportation Division, Department of Civil Engineering, National Institute of Technology, Warangal, 506004, India*
[b] *Transportation Division, Department of Civil Engineering, National Institute of Technology, Warangal, 506004, India*

Abstract

By growing of population, the concept of urban sprawl is increasingly recognised as a serious dilemma among the cities, especially in developing countries. Kabul is one of those cities which are sprawling since two decades and the implication is that residents are suffering from long travel time, pollution and energy consumption. Also, the number of users for public transport and walk are decreasing day by day, and they are shifting to other alternatives. A detailed study to be made in understanding urban sprawl and urban compactness influences on choice mode. This paper is aimed to evaluate the impact of urban sprawl and urban compactness on travel demand for transport modes in 22 districts in Kabul city. Travel demand modelling by using traditional four-step transportation forecasting model for the year 2017 has been applied to assess the current number of passengers for each transport modes (public transport, walk and private transport) in all 22 districts. Secondly, urban compactness based on metrics with two indicators, mixed-use and density measured to figure out the level of sprawl and compactness in each district. Finally, travel demand for transport modes in both circumstances (compact and sprawl areas) compared in observed districts. The extracted outcome presented an interesting vision of variation amongst districts in Kabul city. This study revealed a profound linking between urban sprawl and travel demand for all urban transport modes.

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Keywords: Urban sprawl; Travel demand; Public transport; Walk; Private vehicle

1. Introduction

Urban form is a fundamental element of urban planning which can lead the city towered sustainability or unsustainability. Commonly, the urban form has a positive or a negative effect on residents' quality of life. Urbanization is not a serious threat to the urban environment and urban development than urban sprawl that influences the accessibility to facilities (Zahoor et al., 2017). Furthermore, urban sprawl has been assessed as key problems, such-

* Corresponding author. Tel.: +91-995-905-0431
E-mail address: khalilkakar9@gmail.com

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-as low capacity vehicle dependencies, increasing of pollutions and losing of land resources (Boontore A, 2014).

There are several indicators to determine the level of sprawl such as density, intensification, mixed-use and road network. However, Cervero et al. (1996) stated that two factors (density and mixed-use) of urban form have a keen influence on travel behaviour. Litman et al. (2007) summarised that proper land use management strategies that affect local factors (mixed-use and density) could decrease 10-20% of trips by vehicle per capita. Hence, for safekeeping of cities and successfully operation of transportation system urban planners and engineers purpose various solutions such as compact city, smart city and green city to keep the urban area sustainable for current and future inhabitances.

Kabul city is one of those cities that are facing urban sprawl phenomenon. The city in addition to security problems is combating with long travel time, pollution, energy consumption. Kabul city summarised only by old town (Shar-e-Kohna) with 400 ha in 1916, but after 1962 the urban development accelerated and the buildup area was approached to 86km^2. In the same way, buildup-area was extended to 2,500 ha in 1999, which indicates that during 85 years the city was expended over 62 times. Moreover, since the year 2000, the city was included 16 districts with 2.7 million population and 505.21km^2 area while in 2011 population exceeded 4.5 million and the city expanded to a range of 1023 km^2 (RECS International Inc, 2011). As well as, due to the long travel time commuters are not interested in the public transport and non-vehicle modes. Hence, the number of automobiles increased and as a result, congestions and pollutions are visible in the city. Table 1 indicates the variation of land sprawl and density between the past years.

Table 1. Population, growth and expansion of Kabul city.

Year	Population	Population growth (% /year)	City area (ha)
1700	10,000	-	-
1875	70,000	-	180
1916	65,000	-	400
1925	90,000	3.7	450
1940	120,000	1.9	500
1962	380,000	5.4	6,840
1992	1,500,000	4.7	16,830
1999	1,780,000	2.3	25,000
2005	2,721,000	4.0	1,022,700

Source: Kabul Master Plan (2011)

Currently, one of a sustainable urban form that can be accepted to reduce the role of the automobile and increase the role of the public transport and non-vehicle in Kabul city is the compact city concept. However, the research should be applied before implementation. This paper is intended to explore the impact of urban sprawl on travel demand for public transport, private vehicles and walk. Travel demand modelling and forecasting developed through the traditional four-step method to approach mode choice but the last step (trip assignment) not include of this study. Likewise, the measurement of compactness based on two indicators, density and mixed-use are applied and finally the result determined the variations of travel demand by different modes between compact and sprawl areas. As well as, this study outlined some recommendations regarding prevention of land expansion and improvement of public transport and non-vehicle modes efficiencies.

2. Literature Review

To date, many types of research conducted in the context of urban sprawl or urban compactness influences on transportation system. However, the city planners attempt to decrease traffic and the role of car dependency, but still, the city design concepts and parameters for this issue are not clear (Newman & Kenworthy, 2006). Here some past studies related to the impact of urban sprawl or urban compactness on transportation system are briefly discussed. In sprawl cities, people suffer from lack of transportation management and long travel time that lead the commuters to a high dependency on low capacity vehicles (Zaman 2000; Newman, 1992). Kotharkar et al. (2014) summarised that the concept of compactness preferable than urban sprawl due to the many reasons such as effective use of the land resource, less road network for the transportation system and economic viability. Moreover, Eran (2006) concluded that people density and employment density have a significant impact on travel behaviour and mixed-use, shops, and people facilities have a strong influence on mode choice. As well as, Goodchild (1994), ECOTEC (1993) and Elizabeth Burton (1999) accepted that efficiency of public transportation is better for those areas which have a high level of compactness that people can easily access to stations. While, it is also broadly recognised that in low urban density travel demand for the private car is preferable than the use of public transportation, cycling and walking (Newman and Kenworthy, 1996). Cervero et al. (1997) examined the influence of density, diversity and design on the trip rate and choice mode and finally, the study found that density, land use diversity and pedestrian designs decrease trip rates and encourage non-motorized travel. In same way recently Yi Lu et al. (2018) presented that destination accessibility dramatically affected on the choice of walking and approach to public transport system. Concas et al. (2014) analysed the relationship between density and transit demand. They explore when people live far from their work palaces the demand for transit decrease. Mahriyar et al. (2013) evaluated the relationship between urban form and transportation systems in Surabaya based on 12 variables (population density, build-up density, residential density, school services, health facilities services, percentage of offices in land use, percentage of recreational area, population growth rate and migration rate). Bejleri et al. (2017) measured the level of urban sprawl based on mixed-use, density, road network design and proximity indicators to explore the impact of urban form characteristics on health care providers' accessibility. Ahmad et al. (2014) expressed that decreasing of urban sprawl, protection of the green area and agriculture mitigate demand for private transportation. Moreover, employment density, population density and mix-used have a negative correlation with automobile and a positive correlation with public transport for the purpose of shopping and walk trips (Lawrence D et al. 1994).

From all these studies, are inferred that there is a strong relationship between travel choice and urban sprawl. Therefore, most of the urban planners emphasised or recommend regarding integrating land use and transportation planning. From the part of literature can be easily concluded that there is an important affiliation between build environments and transportation characteristics (travel demand, travel choice, travel length and travel cost). Therefore, this study evaluates the relationship between urban sprawl and travel demand for PT, walk and private transport in 22 districts of Kabul city.

3. Data and Methodology

This chapter discusses regarding the data collection process and methodology. For this research the main data collected through official documents from Kabul municipality, Afghanistan urban and development ministry. Furthermore, secondary information has been used from Kabul master plan (2011). In 2009 survey has been conducted in Kabul city for publishing the new master plan. The surveyors were visited selected houses randomly and defined daily trips of family members who were over five years old. Three categories of survey items determined, namely, household information (number of family members and car ownership), personal information (sex and age) and trip information (origin, destination, trip purposes and transportation modes). The total population of Kabul city in 2008 was determined as 4.01 million. Similarly, 500,000 households placed within the city but the investigation covered 5000 households. The survey has been conducted in all 22 districts. Finally, it is revealed that 4,153 households responded effectively, the total number of family members 30969, average number family members 7.5, number of households owning cars 1638, the ratio of car ownership 39.4 %, the total number of members going out 12179 and total trips who made by responded households were 25643. Then, considering the population of each district, the expansion rates were estimated.

In this study, three phases are considered. Firstly, travel demand modelling and forecasting by using four-step methods (except route assignment) measured. In this phase, the number of trip distribution by modes (walk, public and private transport) for the year 2017 can be assessed. Secondly, by utilisation of metrics (Burton 2002) level of compactness and sprawl were identified in 22 districts. For measurement of urban compactness, two indicators (density, mixed-use) are considered. Finally, in the third phase compact and sprawl districts compared in respect of users for public transport, walking and private vehicle.

3.1. Travel Demand Modelling and Forecasting (Trip Production/Attraction)

For many years four-step travel demand is used to predict number of trips production from a traffic zone and number of trips attraction in a traffic zone considering population, employment or other independent variables (Boarnet et al. 1996). Trip generation is the first step of the four-step method and it determines that how many commuters are generated or attracted in particular traffic zone. Trip generation divided into two parts trip production and attraction. The most common method, linear regression was used to determine the number of trip generation (trip production and trip attraction). For analysing this model, it is required to identify the sets of variables that influence on trip production and trip attraction. These variables can be household attributes. In this study population, employment and car ownership were considered as independent variables for trip production, as well as population, density and employment were used for trip attraction. In following equations, y_1 is dependent variable and indicates the number of trip production in zone i and y_2 is also a dependent variable that shows the value of trip attraction in zone j. In equation (1) x_1, x_2 and x_3 are independent variables and indicated values of population, employment and car ownership respectively. Moreover, in equation (2) x_1, x_2 and x_3 illustrated the rates of population, employment and density. Also, (b) is a regression coefficient, (a) is an intercept constant, (i) and (j) show production and attraction zones. The tables 2 and 3 assessed that there is a positive relationship between independent variables (population, employment, density and car ownership) and dependent variables (trip production/trip attraction). Based on the results correlation coefficient for trip production is (0.95115) and for trip attraction is (0.88714) which indicated the high accuracy of measurements.

$$y_1 = a + b_1(x_1)i + b_2(x_2)i + b_3(x_3)i \qquad (1)$$

$$y_2 = a + b_1(x_1)j + b_2(x_2)j + b_3(x_3)j \qquad (2)$$

The following outcomes that placed in table 4 show the values of trip production and trip attraction in 22 districts. The results only determine trip generation in respect of all modes. Therefore, two more steps are required to apply for approaching the number of commuters by modes.

Table 2. Parameters for trip production.

Variable	Coefficient	Standard Error	T Value
Population	0.31818	0.12909	2.46468
Employment	0.50785	0.12606	4.02839
Car Ownership	5.04607	2.68099	1.88216
Constant	755.076		
Corr. Coefficient	0.95115		

Table 3. Parameters for trip attraction.

Variable	Coefficient	Standard Error	T Value
Population	0.42969	0.09925	4.32931
Employment	0.55843	0.19977	2.79534
Density	3.90182	1.43538	2.71830
Constant	1446.15		
Corr. Coefficient	0.88714		

Table 4. Trip production and attraction in 2009 and forecasted for 2017.

No	Name of District	Production (2009)	Attraction (2009)	Production (2017)	Attraction (2017)
1	Jade Maiwand	105,362	132,978	50,224	107,710
2	Karti Ariana	164,762	191,969	59,222	90,818
3	Diburi	153,242	152,555	91,722	97,113
4	Shari Now	236,698	173,672	228,440	222,277
5	Kote Sangi	255,951	199,636	201,204	191,605
6	Allawoddin	115,117	135,860	151,832	150,654
7	Guzargah	143,106	136,973	213,177	205,334
8	Karte Naw	138,496	153,837	233,599	230,863
9	Microrayan	143,414	140,883	212,887	202,490
10	Bibi Mahroh	256,907	262,360	276,366	269,947
11	Khair Khana	166,372	220,141	141,513	135,943
12	Harzan Q	95,613	97,789	133,267	135,432
13	Dashte Barchi	72,080	78,342	211,550	210,977
14	Qargha	72,080	78,342	931,65	79,578
15	Qasaba	236,274	189,751	288,664	260,897
16	Microrayan K	57,708	86,940	112,645	113,237
17	Kotal	50,931	39,880	195,196	200,031
18	Paimonar	2,963	7,731	308,342	317,037
19	Dehsabz	12,436	10,110	264,955	272,379
20	Reshkhor	26,119	17,487	101,951	99,053
21`	Pole Charkhi	26,119	17,487	65,537	41,735
22	Kamari	11,222	15,879	57,511	57,859
Total		2,542,972	2,540,602	3,692,969	3,692,969

Trip generation and attraction are estimated based on socio-economic data such as population, employment, density and car ownership. In equations (1) and (2), x1 and x2 indicated the values of population and employment. In this study, the rate of variables (population and employment) are interpolated based on existing data in Kabul master plan. In Kabul master plan the data for population and employment collected in 2009 and predicted by Kabul Municipality and JICA for 2025 in each district individually. The accessible data in the master plan indicates that there are notable differences between the values of collected variables in 2008 and predicated variables for 2025. For example, in district 21 the population is 3379 in the year 2009 and predicted value for the year 2025 is 199,598. Furthermore, in district 22 the employment is 19,213 in the year 2009 and predicted value for the year 2025 is 174,294.

Consequently, there are some differences between indexes of trip generation and attraction in 2009 and 2017.

3.2. Travel Demand Modelling and Forecasting (Trip Distribution)

Trip distribution analysis aims to identify trip linkage between traffic zones. It indicates the number of trips that arise between origin and destination zones. Generally, trip distribution specifies how many number of trips move from generated zone to attracted zone. There are various models to analysis trip distribution, such as Gravity model, BPR gravity model, Voorhees Gravity model, Opportunity model. The Gravity model (type one) is considered for this study which is illustrated by the following equation.

$$T_{ij} = K({G_i}^{\alpha} * {A_j}^{\beta})/{D_{ij}}^{\gamma} \quad (3)$$

T_{ij} – Trip Distribution among zone i and j

G_i – Trip generation in zone i
A_j – Trip attraction in zone j
D_{ij} – Impedance (trip length km from zone i to j)
α, β, γ – coefficients
K- Constant

In the above equation, G_i is a trip generation in zone i and A_i is a trip attraction in zone j which are estimated in section 3.1. D_{ij} is impedance and indicated the minimum length of route (km) between two intended district centroids. Equation (3) or gravity model related to Newton's theory which is used for measurement of trip distribution. Figure 1 indicated desired lines or trip distribution in 22 districts by all modes as well as it is apparent that more trips were concerted in district 10. Likewise, the correlation coefficient with the value of 0.77883 (Table 5) indicated the high accuracy of measurement.

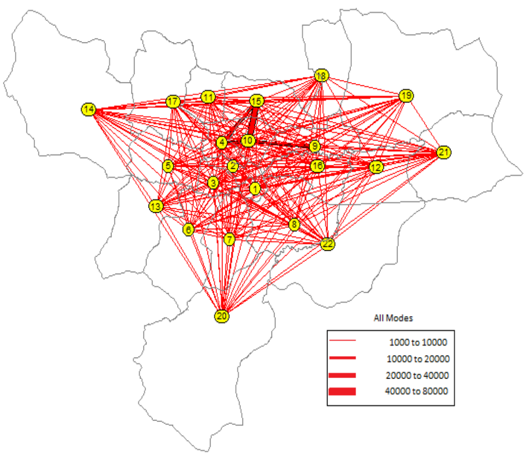

Figure 1. Trip distribution (desired lines) by all modes in 22 districts.

Table 5. Trip distribution parameters.

Variable	Coefficient	Standard E	T Value
α	0.78852	0.05268	14.9655
β	0.71996	0.05918	12.1646
γ	-0.8886	0.09025	-9.8462
k	3752.51		
Corr. Coefficient	0.77883		

3.3. Travel Demand Modelling and Forecasting (Modal Split Model)

The modal split model measured based on average travel time between the districts i and j. The modal split model is the third step of traditional four-step method which illustrates commuters' choice or interest regarding available modes within the districts. Modal split model is aimed to determine the number of trips by individual mode. In this study the Growth Curve Function (equation 4) is used for determination of modal split. In following equation, P_{ij} indicates modal share from zone i to j, t_{ij} shows the average travel time from zone i to j.

At the beginning, total trips in each district divided into two parts, non-vehicle and vehicle. Then, trips by vehicle parted into public transport and private transport (Figure 2). Average speed for walking, vehicle, public transport and private transport are assumed as 3.5, 35, 20 and 55 (km/h) respectively. Finally, the following step provided information about the number of commuters for public transport, private transport and walk as presented in table 6.

$$pij = \frac{1}{1+e^{(atij+b)}} \tag{4}$$

Pij – Modal share
Tij – Average Travel Time between district i to j
a b – Parameters

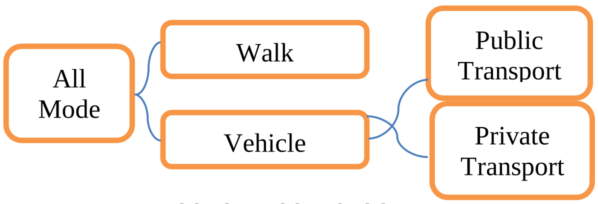

Figure 2. Modal split model methodology.

Table 6 indicates in Bibi Mahroh, Chaman and Khair khana the percentages of commuter who are used public transport and walk are high compared to other areas. While in the mentioned areas, the percentages of people that use private transport are less than the rest of the other areas. Unlike, in Reshkhor and Paimonar more people are interested in private transport. The result of mode split presents variations between the commuters' choice mode in each district.

Table 6. Trip Generation by various transport mode in observed areas.

Number of District	Name of District	Walk	Walk (%)	Public Transport	Public Transport (%)	Private Transport	Private Transport (%)	All Mode
1	Jade Maiwand	5022	10	26161	52	19041	38	50224
2	Karti Ariana	6235	11	31028	52	21959	37	59222
3	Diburi	10022	11	48352	53	33348	36	91722
4	Shari Now	25643	11	122131	53	80667	35	228441
5	Kote Sangi	24979	12	109528	54	66698	33	201205
6	Allawoddin	18047	12	82194	54	51591	34	151832
7	Guzargah	30994	15	119746	56	62437	29	213177
8	Karte Naw	33229	14	128848	55	71523	31	233600
9	Microrayan	20198	9	102490	48	90199	42	212887
10	Bibi Mahroh	49622	18	159084	58	67660	24	276366
11	Khair Khana	21265	15	78925	56	41322	29	141512
12	Harzan Q	15985	12	71533	54	45748	34	133266
13	Dashte Barchi	28097	13	117363	55	66089	31	211549
14	Qargha	12588	14	49591	53	30986	33	93165
15	Qasaba	26000	9	138135	48	124529	43	288664
16	Microrayan K	18752	17	63902	57	29990	27	112644
17	Kotal	20536	11	103038	53	71621	37	195195
18	Paimonar	23790	8	145779	47	138773	45	308342
19	Dehsabz	35491	13	137739	52	91725	35	264955
20	Reshkhor	9101	9	47995	47	44855	44	101951
21`	Pole Charkhi	7901	12	33816	52	23820	36	65537
22	Kamari	5687	10	27427	48	24397	42	57511
Total		449184		1944804		1298978		3,692,969

3.4. Measurement of urban compactness

Based on Burton (2002) literature, there are three indicators (density, mixed-use and intensification) to measure the level of sprawl and compactness. While D. Stathakis and G. Tsilimigkas (2013) calculated the level of compactness in Europe cities by using density and mixed-use. Morever, Kenworthy et al. (1996) expressed that high density is one of the important indicators of urban form that reduces travel time, improves public transport and enhances the viability of walking and cycling.

In this study, density and mixed-use are considered as indicators for measurement of urban compactness or level of sprawl in 22 towns in Kabul city based on metrics available in the literature. In this measurement built-up areas including residential, governmental, commercial, industrial areas, airport, roads, and parks. Density indicator consists of population density, residential density and build density. The following steps are proceeded to approach the objective.

1) densgr1 = resident population in district / total area of district (person / ha)
2) densblt1 = resident population in district / build-up area (person / ha)
3) densres1 = resident population in district / residential area (person / ha)
4) supfacs2 = residential / non-residential area

It is required to standardize all the values which are derived from the above procedure. Therefore, the following stage has been used.

5) Standardized value = value – mean / standard deviation

The remaining steps have been indicated step by step in table 7.

Table 7. Measurements of urban sprawl or level of compactness in 22 district of Kabul city.

dis name	population	dis area (ha)	build-up (ha)	Residential (ha)	densgr 1	densbl t1	denser 1	mixed-use 2	dens	compact
	a	b	c	d	A	B	C	D	F	G
Jade Maiwand	36727	483	332	124	-0.206	-1.017	-0.299	-0.57	-0.51	-0.54
Karti Ariana	127993	684	590	257	1.709	0.328	-0.242	-0.40	0.60	0.10
Diburi	81715	911	822	414	0.029	-1.159	-0.327	-0.17	-0.49	-0.33
Shari Now	189086	1172	1128	598	1.264	-0.296	-0.293	-0.07	0.23	0.08
Kote Sangi	332403	2845	1532	894	0.497	0.329	-0.278	0.19	0.18	0.19
Allawoddin	288912	4918	1671	957	-0.504	-0.229	-0.297	0.13	-0.34	-0.11
Guzargah	452806	3334	2136	1,478	0.824	0.266	-0.296	0.98	0.26	0.62
Karte Naw	576835	4825	1837	1,124	0.544	1.557	-0.238	0.35	0.64	0.5
Microrayan	189919	2433	1803	616	-0.171	-1.084	-0.296	-0.64	-0.52	-0.58
Bibi Mahroh	246849	1303	1081	885	1.749	0.473	-0.304	3.11	0.65	1.87
Khair Khana	273923	1742	1265	829	1.194	0.323	-0.289	0.66	0.42	0.53
Harzan Q	424138	3490	2218	1,221	0.578	0.003	-0.285	0.02	0.11	0.06
Dashte Barchi	435384	4719	2698	1,660	0.073	-0.375	-0.308	0.37	-0.20	0.08
Qargha	210977	11902	951	524	-1.212	0.390	-0.269	0.02	-0.36	-0.17
Qasaba	207553	3253	2000	626	-0.417	-1.104	-0.289	-0.70	-0.60	-0.65
Microrayan K	325245	2507	941	713	0.720	1.957	-0.254	1.81	0.81	1.31
Kotal	327575	5602	1543	780	-0.509	0.270	-0.264	-0.17	-0.17	-0.17
Paimonar	52722	3388	584	121	-1.249	-1.275	-0.260	-0.88	-0.93	-0.90
Dehsabz	184369	14143	1586	11	-1.292	-0.946	4.308	-1.12	0.69	-0.22
Reshkhor	174334	14294	1319	152	-1.307	-0.745	-0.061	-1.00	-0.70	-0.85
Pole Charkhi	107260	6395	281	22	-1.228	2.414	0.983	-1.05	0.72	-0.16
Kamari	221462	7925	1243	258	-1.035	-0.162	-0.142	-0.88	-0.45	-0.66

For more explanation the level of compactness only for one district (Jade Maiwand) estimates as following:
Name of District: Jade Maiowand.
Population (a): 36727
Dis area (b):483 ha
Build up area (c): 332 ha
Residential area: 124 ha

$$Densgr\ 1(A) = [(a \div b) - mean] \div SD = \{[(36727 \div 483) - 88] \div 58\} = -0.206$$

$$Densblt\ 1(B) = [(a \div c) - mean] \div SD = \{[(36727 \div 332) - 191] \div 79\} = -1.017$$

$$Denser\ 1\ (C) = [(a \div d) - mean] \div SD = \{[(36727 \div 124) - 1364] \div 3570\} = -0.299$$

$$Mixed - use\ (D) = \{[(d \div (c - d)\ ] - mean\} \div SD = \{[124 \div (332 - 124)\ ] - 1.2\} \div 1.07 = -0.57$$

$$F = [(A + B + C)/3] = [(-0.206) + (-1.017) + (-0.299)/3] = -0.51$$

$$G = [(D + F)/2] = [(-0.57) + (-0.51)] = -0.54$$

Table 8. Travel demand for all modes in compact and sprawl areas in Kabul city.

District No	District Name	Level of Sprawl	Walk Users (%)	Public Transport Users (%)	Private Transport Users (%)
10	Bibi Mahroh	1.87	18	58	24
16	Microrayan Kohna	1.31	17	57	27
8	Karte Naw	0.5	14	55	31
11	Khair Khana	0.53	15	56	29
7	Guzargah	0.62	15	56	29
2	Karti Ariana	0.10	11	52	37
5	Kote Sangi	0.19	12	54	33
4	Shari Now	0.08	11	53	35
12	Harzan Q	0.06	12	54	34
13	Dashte Barchi	0.08	13	55	31
21	Pole Charkhi	-0.16	12	52	36
17	Kotal	-0.17	11	53	37
6	Allawoddin	-0.11	12	54	34
14	Qargha	-0.17	14	53	33
3	Diburi	-0.33	11	53	36
1	Jade Maiwand	-0.54	10	52	38
19	Dehsabz	-0.22	13	52	35
9	Microrayan	-0.58	9	48	42
22	Kamari	-0.66	10	48	42
15	Qasaba	-0.65	9	48	43
20	Reshkhor	-0.85	9	47	44
18	Paimonar	-0.9	8	47	45

4. Result and Discussion

Table 6 indicates the percentages and number of passengers who use public transport, private transport and waking in 22 observed districts. The result illustrates distinct values in respect of users' percentage for different modes. Table 7 distinguished the areas with high level of compactness, low level of compactness and sprawl districts comparatively. The outcome revealed that districts 1, 2, 9, 13, 14, 15, 17, 18, 19, 20 and 22 are sprawl areas and districts 2, 4, 5, 12, and 21 are the districts with low level of compactness. In contrast, districts 10, 16, 8, 11, and 7 defined the areas with high level of compactness comparatively.

This section assessed the impact of urban sprawl and urban compactness on travel demand through the combination of tables 6 and 7. Finally, the outcomes (Table 8) explained that in sprawl areas (Paimonar, Reshkhor, Qasaba, Kamari, Microrayan, Dehsabz, Jade Maiwand, Diburi, Qargha, Allawoddin, Kotal and Dashte Barchi) fewer percentage of people interested in walking and using of public transportation than the compact areas (Bibi Mahroh, Microrayan Kohna, Karte Naw, Khair Khana and Guzargah). Unlike, the people who live in those districts with the high level of sprawl more interest in private transport than the other observed districts.
The areas, such as Karti Arian, Qalai-i-Wazir, Shar Naw, Harzan Q and Pole Charkhi represented minor sprawl districts and the percentage of people in these areas who are used public transport and walk are more than sprawl areas and less than compact areas. The result shows that Bibi Maharoh, Microrayan Kohna, Chahl Sotun, Khair Khana are the most compact areas in Kabul city. Hence, the percentage of users for public transport and walk are high than other districts. In contrast, within compact areas, fewer percentage of passengers interested in private transport than non-compact districts. Finally, the research disclosed that in sprawl areas people are more interested in low capacity vehicle and they are less interested in walking and public transport system. Accordingly, it is required to enhance land use management strategies in respect to high density and mixed-use factors. Therefore, the research recommends the following strategies.

1) Improvement and arrangement of build environment (building, roads, parks), business activities within each sprawl district.
2) Prevention of land expansion through green belt and ring road around the districts.
3) Segregation of traffic and pedestrian to encourage people for walk.
4) Enhancement of sprawl districts' environment where residents can live, work, shop and move around by walk.
5) Introducing segregated right of way for public transport from CBD (Jade Maiwand) to other districts.
6) Reduction of vehicles in automobile-dependent districts by introducing strong center that representing high density, mixed-use and well public transit system.

5. Conclusion

This research revealed that there are a profound relationships between urban form (urban sprawl and compact city) and urban transportation systems. The result shows, by increasing of urban sprawl number of commuters for walk and public transport decrease. While the same condition improves car dependency and people are more interested in using private vehicles. But in the case of compact areas, this research specified that more inhabitances like to use public transport and walk than those who live in sprawl areas. As well as, the areas which have a high level of compactness the utilization of private transport are less than areas which have a high level of sprawl. The investigation base on density and mixed-use finally discovered that Kabul city includes compact areas, sprawl areas and fewer sprawl districts. These urban forms influenced on travel demand for all transportation systems. Therefore, to improve transportation systems and encourage passengers to walk and use public transport system, it is recommended to improve the compact city and transit-oriented development concepts in sprawl and fewer sprawl districts.

Additionally, it is significant to express that, this study only considered the impact of mixed-use and density on modal share. While, location of residential, business and level of service attributes (reliability, frequency, accessibility, travel time, travel cost, ease of transfer, vehicle condition, comfort and safety) also are the consequential features, concerning modal share. Hence, this study recommends more research regarding to approach the comprehensive result in Kabul city about the modal share relationship with the above attributes.

Acknowledgement

The secondary date were used in this research prepared and offered through Kabul Municipality and Ministry of Urban Development. The authors would like to express their appreciation to both organisations for supporting this study.

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