The Scientific Temper (2024) Vol. 15 (2): 2362-2374
E-ISSN: 2231-6396, ISSN: 0976-8653
Doi: 10.58414/SCIENTIFICTEMPER.2024.15.2.52
https://scientifictemper.com/

RESEARCH ARTICLE

Can Shimla be fitted into the compact city model?

Renuka Thapliyal

Abstract

Major dimensions of the compact city are mixed land use, high density, accessible & efficient transport, more use of public mode, better pedestrians, and more walkability. This paper has examined Shimla's scenario with respect to mixed land use and high density and assessed whether the compact city model can be applied to Shimla. It has also analyzed the household data of Shimla collected during 2010-11 by the author with respect to some components such as built-up area, density, trip length and modes of transport used by the people.

Keywords: Compact city, Mixed land-use, Sprawl, Sustainability.

Introduction

Urban planning has always remained an important field of study as cities developed for different purposes, such as economic, political, cultural and, religious, etc., during different time periods. Right from the era of the Indus Valley civilization 'design' used to be an important aspect of urban planning. The modern concept of city planning came with industrialization in the second half of the nineteenth century, primarily with Britain and other European countries. However, the developments led to the creation of various urban forms but impacted the environment adversely. The development of road and rail transport allowed settlements to grow outside the traditional cities. With more congestion and pollution in the city, affluent people started to move out and sprawl became the consequence of backlash. This was further accelerated by the expansion of transport infrastructure. Per capita, automobile ownership began to increase dramatically, especially in the US and New Zealand. In 1920 there was one automobile for every eleven people in the US and by 1930 this had dramatically changed to one automobile for every four and a half people (Southworth 2001 cf. Arbury 2005:21). Spatial disconnection between home and workplace increased due to increased private transportation. Not only the development of transportation but the framing of policies and zoning of different land uses were responsible for urban sprawl. This low-density, automobile-dependent, single-use, aggravating traffic congestion due to increased commuting, more resource consumption (excessive land consumption), and amorphous and isolated development had its negative impacts (Carruthers and Ulfarsson 2002). Sprawl or dispersed developments have been considered to contribute more towards air pollution and consume more energy than the compact city. The sprawl developments, which are more attractive to middle and high-income groups and developers, incur severe economic, environmental, and social costs. The expenditure incurred on laying water and sewer lines and construction of roads is far less for compact cities than for dispersed settlements. The peripheral areas are more environment friendly but sprawl increases resource use.

Although urbanization is expected more in the growing economies of Asia and Africa, the low density-sprawled population of North America, Europe and Australia consume more resources (Haughton and Hunter 1994 cf. Arbury 2005). The negative socio-economic and environmental impacts of urban sprawl have led the vast majority to accept its unsustainable nature. The concept of sustainability and the compact city came to combat this adverse impact on the environment. Hence compact city has now become the choice of planners and policymakers and as an alternative to sustainability. A compact city is defined as a 'relatively high-density, mixed-use city, based on an efficient public transport system and dimensions that encourage walking and cycling' (Burton 2000: 1969). Intensification, i.e., conversion of wasteland and lower density to higher density land-use within the city boundary efficiently, is considered more sustainable from the point of view of

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How to cite this article: Thapliyal, R. (2024). Can Shimla be fitted into the compact city model?. The Scientific Temper, **15**(2):2362-2374.
Doi: 10.58414/SCIENTIFICTEMPER.2024.15.2.52

Source of support: Nil

Conflict of interest: None.

Received: 01/04/2024 **Accepted:** 01/05/2024 **Published**: 15/06/2024

resource use, environment, and socio-economic conditions. Critics of the compact city concept claim that higher urban densities imply greater use of urban green or open land for development (Breheny, 1992; Knight, 1996). This opinion is also critiqued for its being radical, utopian, and impossible to implement in a feasible manner acceptable to people. Critics argue that parks and other open spaces are plentiful in low-density cities; low-income households rarely have to walk or drive far to reach such space, thus saving travel time and money.

However, a possible advantage of a compact city is that it may be easier to access open countryside beyond its boundaries. Newman and Kenworthy (1989a) have provided perhaps the most well-known evidence. Their work has suggested that higher-density cities are associated with high use of public transport. Mixed-use development can also increase economic sustainability for local businesses, as they are located within close proximity of a greater number of people, therefore increasing 'foot traffic' and improving social equity through decreasing the need to own an automobile to access many of the destinations required by local residents. Salingaros (2006) has given the negative points of both ultra-high-density environments based on skyscrapers and low-density suburban sprawl no longer feasible. The urban design of Auckland was critiqued for intensification and the creation of chicken-coop apartments and slums. Finally, transit-oriented developments were suggested for growth by management strategies.

The only alternative he has suggested is the smaller-scale, compact city with optimal densities, ideally surrounded by and close to agricultural lands for local food supply.

In urban planning, certainly, urban sprawl is not a desirable model but the compact city model also has some negative impacts. The literature review also shows that the current growth pattern is more of smart growth or the compact city.

Factors Leading to Sprawled Conditions

- Car driven
- Separation of residence from other activities distance-wise (zoning)
- Location of facilities beyond walking distance
- Public transportation does not remain a viable option and people are forced to use private automobiles

From the review of the literature (Arbury 2005; Leck 2006; Salingaros 2006; Long and Huang 2017) the various aspects identified contributing towards the compact city are as follows:

- Livable environment
- Accessible and efficient transport (to work, education, public space, etc.)
- Maximum use of public transport
- Mixed land use and reduced need for transport
- Community's support for a change of lifestyle
- Efficient use of resources
- Needs of pedestrians to be kept in mind while planning (more walkability)
- Quality urban design or new urbanism

The Study Area, Data, and Methodology

Shimla, the state capital of Himachal Pradesh, is located at 31°6' North latitude and 77°13' East longitude at an elevation of 7116 feet above mean sea level (Gazetteer of the Shimla District, 1888-89: 2). The city is spread over seven hills namely Jakhu, Observatory, Prospect, Elysium, Summer, Potter and Museum Hill. The population of the city has grown over the century from merely 14335 to 169758 in 2011 (Gazetteer of the Shimla district, 1888-89: 110; census of India, 2011). The density of the population has increased from 2350 persons km^2 in 1961 to more than 5,000 persons per km^2 in 2011 (Census of India, 1971 and 2011). The Census area of Shimla MC has increased from 19.55 km^2 in 1991 to 28.53 km^2 in 2001 and 35.34 km^2 in 2011. The area is divided into 25 wards. Shimla is also a popular tourist destination.

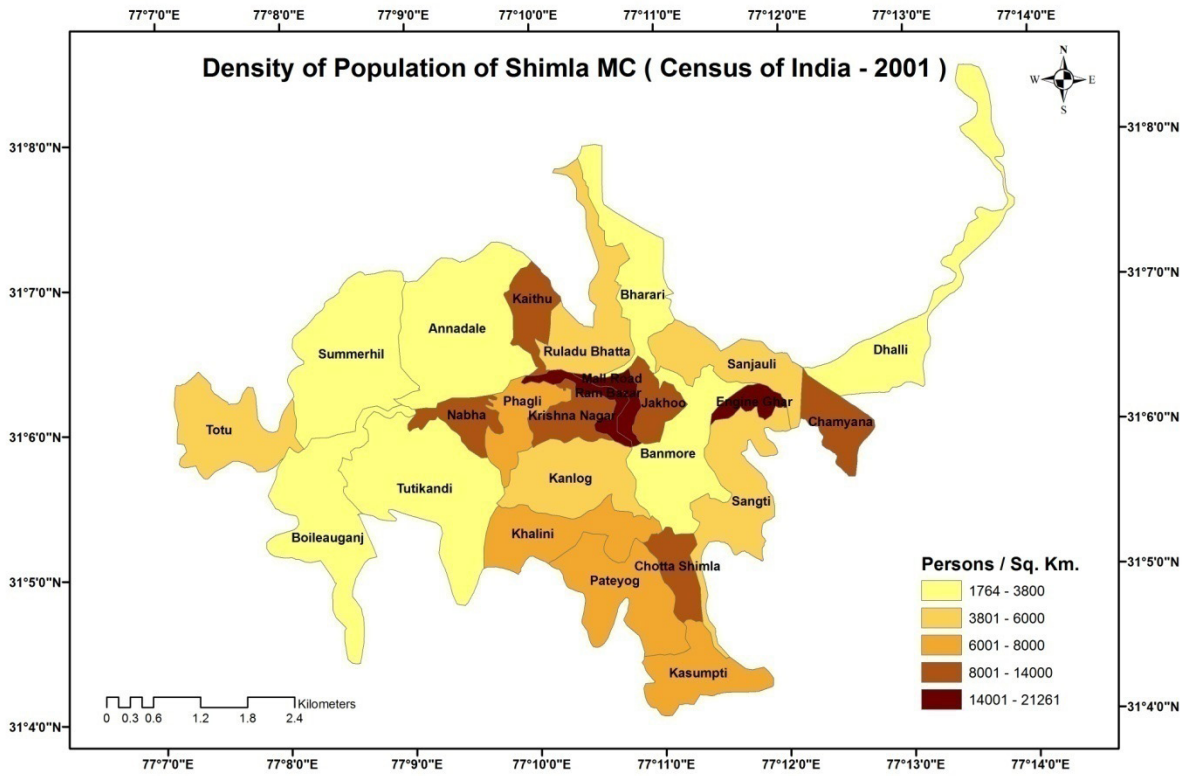
This study is based on a survey of 400 households conducted in December 2010-April 2011 in Shimla. It is a part of research (Thapliyal, 2016) on developing indices for various dimensions of a sustainable city. The required number of households was selected from each ward based on the proportion of the population as per the census, 2001. Within the wards, random sampling was used to identify the households for administering the survey questionnaire. For this study, we extracted data pertaining to the socio-economic characteristics of the population, availability of transport infrastructure, views on other problems faced by city residents, and a set of questions on perceptions of the transport system and travel preferences. Primary data is used for analysis along with secondary Census data. Analysis of travel patterns of residents to various activities has been done to understand the compactness of city.

Fitting Shimla into a Compact City Model

Although a number of components constitute a compact city this study focuses on mixed land-use and high density to understand whether the compact city theory can be adequately adapted to Shimla's situation. The main factors are built-up area, density, trip length and modes of transport used by the residents.

Density and Shimla

Shimla is a high-density city and the Municipal Corporation comprises 25 wards. According to the census of India 2001, the density of Shimla is around 5000 persons/km^2 and the densest ward is Mall road, situated in the core of the city. Table 1 presents the ward-wise density of the population in Shimla as per the census of India 2001. Map 1 gives the spatial distribution of population density in Shimla.



Source: Ward-wise Population Density of Shimla MC according to Census of India 2001

Map 1: Spatial distribution of population density of Shimla city

Table 1: Ward-wise density of population in Shimla

S. No.	*Ward name*	*Population density (Persons/Sq Km)*	*S. No.*	*Ward name*	*Population density (Persons/Sq Km)*
1	Bharari	3598	14	Jakhoo	8128
2	Ruladu Bhatta	5104	15	Banmore	3249
3	Kaithu	8193	16	Engine Ghar	20641
4	Annandale	1961	17	Sanjauli	5042
5	Summerhill	2114	18	Dhalli	3296
6	Totu	5765	19	Chamyana	11733
7	Boileauganj	3626	20	Sangti	4716
8	Tutikandi	1764	21	Kasumpti	7710
9	Nabha	10297	22	Chhota Shimla	8383
10	Phagli	6813	23	Pateyog	7842
11	Krishna Nagar	11845	24	Khalini	6021
12	Ram Bazar	14630	25	Kanlog	3803
13	Mall Road	21261			

Source: Ward-wise Population Density of Shimla MC according to Census of India 2001

The pattern of movement of people in different wards of Shimla

- *Density, mode of transport and travel distance*

In Shimla how people belonging to different density regions in different wards reach different destinations by using different modes of transport to different distances determines the general travel pattern, the amount of congestion on roads, and traffic.

During the survey conducted in the year 2010-2011, the total number of persons in the work category was 616, and out of this 30% had to go a distance of 1 to 2 km and

Table 2: Ward-wise percentage of people going for work to various distances

	< 1 Km	*1–2 Km*	*3–5 Km*	*6–10 Km*	*11 Km and above*	*Total*
Bharari	0	56	12	24	8	100
Ruladu Bhatta	23	39	32	7	0	100
Kaithu	0	50	30	10	10	100
Annandale	9	13	61	9	9	100
Summerhill	0	64	16	20	0	100
Totu	10	27	7	50	6	100
Boileauganj	15	22	27	32	5	100
Tutikandi	0	11	33	39	17	100
Nabha	0	15	55	20	10	100
Phagli	25	5	40	20	10	100
Krishna Nagar	7	36	57	0	0	100
Ram Bazar	57	43	0	0	0	100
Mall Road	20	55	15	0	10	100
Jakhoo	29	43	29	0	0	100
Banmore	20	47	20	0	14	100
Engine Ghar	19	6	19	31	26	100
Sanjauli	0	42	37	21	0	100
Dhalli	24	33	0	38	5	100
Chamyana	11	14	30	30	17	100
Sangti	4	16	40	16	24	100
Kasumpti	0	13	41	38	9	100
Chotta Shimla	13	53	20	13	0	100
Pateyog	7	16	36	33	9	100
Khalini	24	33	21	21	0	100
Kanlog	9	50	32	9	0	100
Total	12	30	29	21	7	100

Source: Based on primary data collected by the researcher during 2010-11

29% had to go 3 to 5 km. Around 71% of people cover less than 5 km and 28% travel for 5 to 10 km or more. Of all the wards, it was found that the closer the wards are to the core area lesser the distance people have to cover to go to their workplaces. Almost 100% of people cover a distance of up to 2 km in Rambazar ward, 75% in Mall road, 72% in Jakhoo, and 67% in Banmore. These wards are close to the core of the city. In the distant wards like Totu, Boileauganj, Tutikandi, Dhalli, Kasumpti, Pteyog and Chamyana, more than 30% of people travel 6 to 10 km for work trips. Table 2 presents the ward-wise percentage of people going to work various distances.

For education, 41% of students cover a distance of 1 to 2 km, 32% cover 3 to 5 km, 20% of students have to go 6 to 10 km and 6% go more than 10 km. In Bharari, Ruladu Bhatta, Totu, Krishnanagar, Ram Bazar and Sanjauli, above 61% of people go 1 to 2 km. In Kaithu, Annandale, Boileauganj, Phagli, Banmore, Chotta Shimla, Pateyog and Kanlog,

Table 3: Ward-wise percentage of students travelling for education to various distances

Education	*< 1 Km*	*1–2 Km*	*3–5 Km*	*6–10 Km*	*11 Km and above*	*Total*
Bharari	0	63	25	13	0	100
Ruladu Bhatta	0	70	22	7	0	100
Kaithu	0	42	53	5	0	100
Annandale	0	27	73	0	0	100
Summerhill	0	50	28	22	0	100
Totu	0	62	14	19	5	100
Boileauganj	0	20	50	30	0	100
Tutikandi	0	0	15	70	15	100
Nabha	13	47	40	0	0	100
Phagli	0	0	50	40	10	100
Krishna Nagar	0	67	33	0	0	100
Ram Bazar	0	79	7	7	7	100
Mall Road	0	55	40	5	0	100
Jakhoo	0	57	29	7	7	100
Banmore	0	31	56	13	0	100
Engine Ghar	8	33	25	25	8	100
Sanjauli	0	65	12	18	6	100
Dhalli	11	33	22	28	6	100
Chamyana	0	35	24	28	14	100
Sangti	0	48	24	16	12	100
Kasumpti	3	17	14	48	17	100
Chotta Shimla	0	27	64	9	0	100
Pateyog	3	19	51	22	5	100
Khalini	0	41	22	30	7	100
Kanlog	0	41	55	5	0	100
Total	2	41	32	20	6	100

Source: Based on primary data collected by the researcher during 2010-11

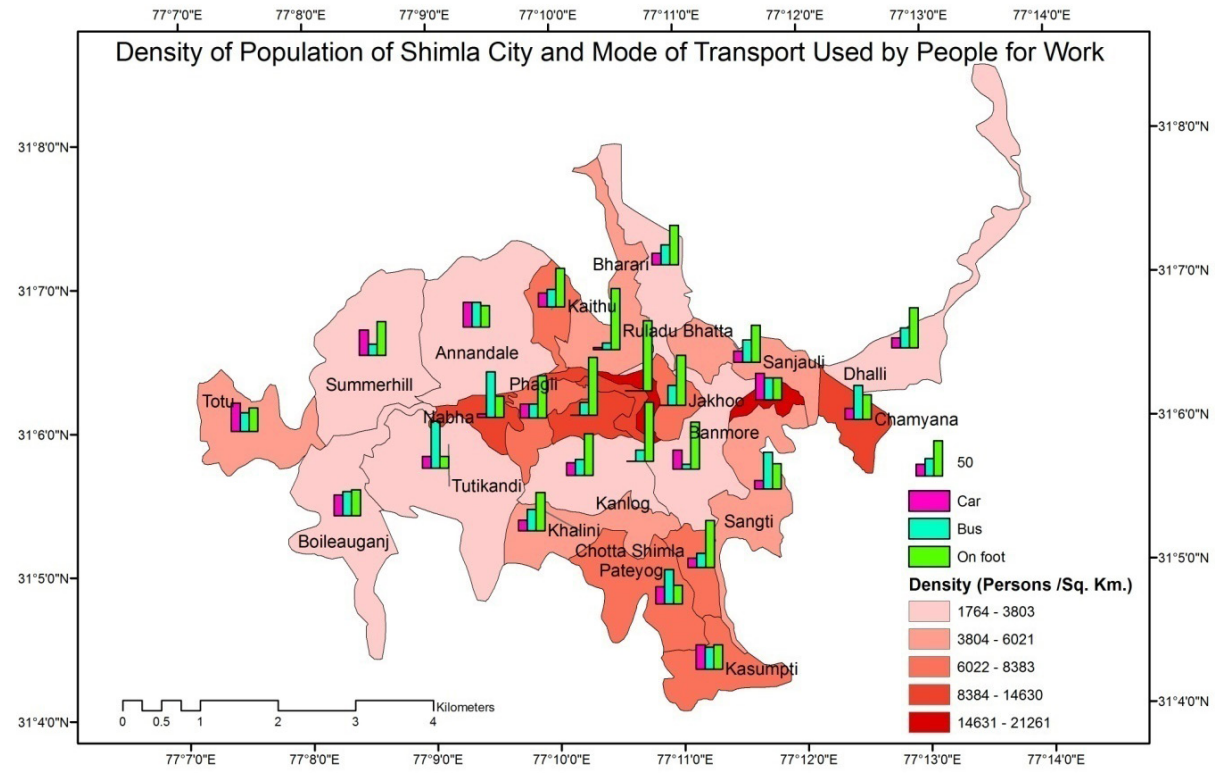
more than 50% of students cover a distance of 3 to 5 km. In Tutikandi, 70% of students go 6 to 10 km, whereas in Ksumpti the percentage is 48. In Tutikandi, Chamyana, Sangati and Kasumpti, more than 12% of students cover 11 to 20 km. Table 3 shows travel distances for education.

Density and travel

Here, we have tried to find out whether density affects the length of distance traveled per person.

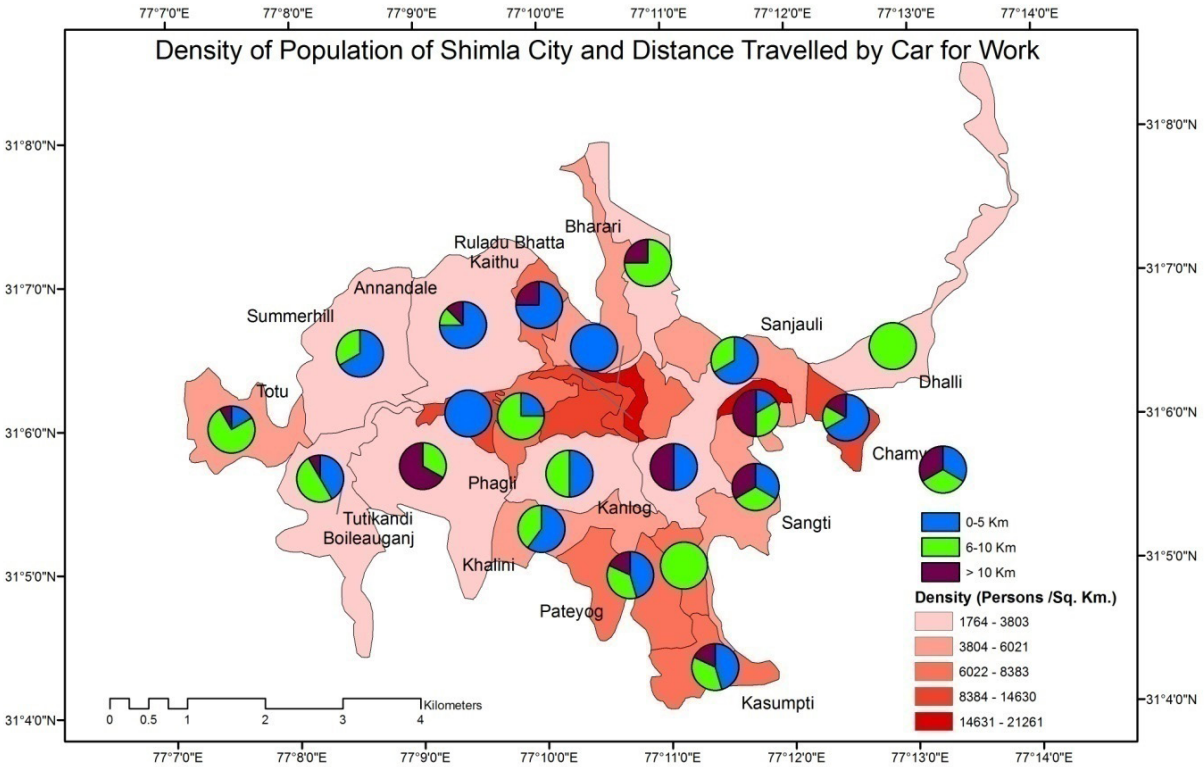
- *Assertion*
  - The higher the distance traveled by people lesser the density of an area.
  - Mode of transport used by people in different density areas.

Map 2 presents the density of the population of Shimla city and the mode of transport used by people for work. Central and southern wards are denser and people walk more in the central wards. The use of private vehicles and buses is relatively high in less dense outer wards such



Source: Based on primary data collected by the researcher during 2010-11

Map 2: Density of the population of Shimla city and mode of transport used by people for work



Source: Based on primary data collected by the researcher during 2010-11

Map 3: Density of population of Shimla city and distance traveled by car for work

as Tutikandi, Annandale, Boileauganj and Totu. Better pedestrians and walk spaces in and around the core area increase walkability, which is visible on the map.

Movement of people to various distances by car and their relationship with the density of wards

The following table shows that the central wards like Mall Road, Rambazar, Krishna Nagar and some of the outer wards like Totu, Pategog, Kasumpti, Chamyana are denser. Travel distance is less in the central areas of higher density and the wards surrounding the core area. It means most of the jobs are located in central areas. Travel distance is greater in outer wards which suggests that the people are traveling towards central areas for work. Table 4 presents the ward-wise percentage of people going to work by car to various distances. Map 3 shows a relationship between the density of the population of Shimla city and the distance traveled by car for work.

Table 4: Ward-wise percentage of people going to work by car to various distances

Ward	*< 1 km*	*1–2 km*	*3–5 km*	*6–10 km*	*11 km and above*	*Total*
Bharari	0	56	12	24	8	100
Ruladu Bhatta	23	39	32	7	0	100
Kaithu	0	50	30	10	10	100
Annandale	9	13	61	9	9	100
Summerhill	0	64	16	20	0	100
Totu	10	27	7	50	6	100
Boileauganj	15	22	27	32	5	100
Tutikandi	0	11	33	39	17	100
Nabha	0	15	55	20	10	100
Phagli	25	5	40	20	10	100
Krishna Nagar	7	36	57	0	0	100
Ram Bazar	57	43	0	0	0	100
Mall Road	20	55	15	0	10	100
Jakhoo	29	43	29	0	0	100
Banmore	20	47	20	0	14	100
Engine Ghar	19	6	19	31	26	100
Sanjauli	0	42	37	21	0	100
Dhalli	24	33	0	38	5	100
Chamyana	11	14	30	30	17	100
Sangti	4	16	40	16	24	100
Kasumpti	0	13	41	38	9	100
Chotta Shimla	13	53	20	13	0	100
Pateyog	7	16	36	33	9	100
Khalini	24	33	21	21	0	100
Kanlog	9	50	32	9	0	100
Total	12	30	29	21	7	100

Source: Based on primary data collected by the researcher during 2010-11

Movement of people to various distances by bus and their relationship with the density of wards

Except for Annandale and Sangti in all the outer wards for work, people travel a distance of around 6 to 10 Km by Bus. In central wards and the wards adjacent to them, people travel 3 to 5 Km. Table 5 shows the wardwise percentage of people going to work by bus to various distances. Map 4 represents a relationship between the density of the population of Shimla city and the distance traveled by bus for work.

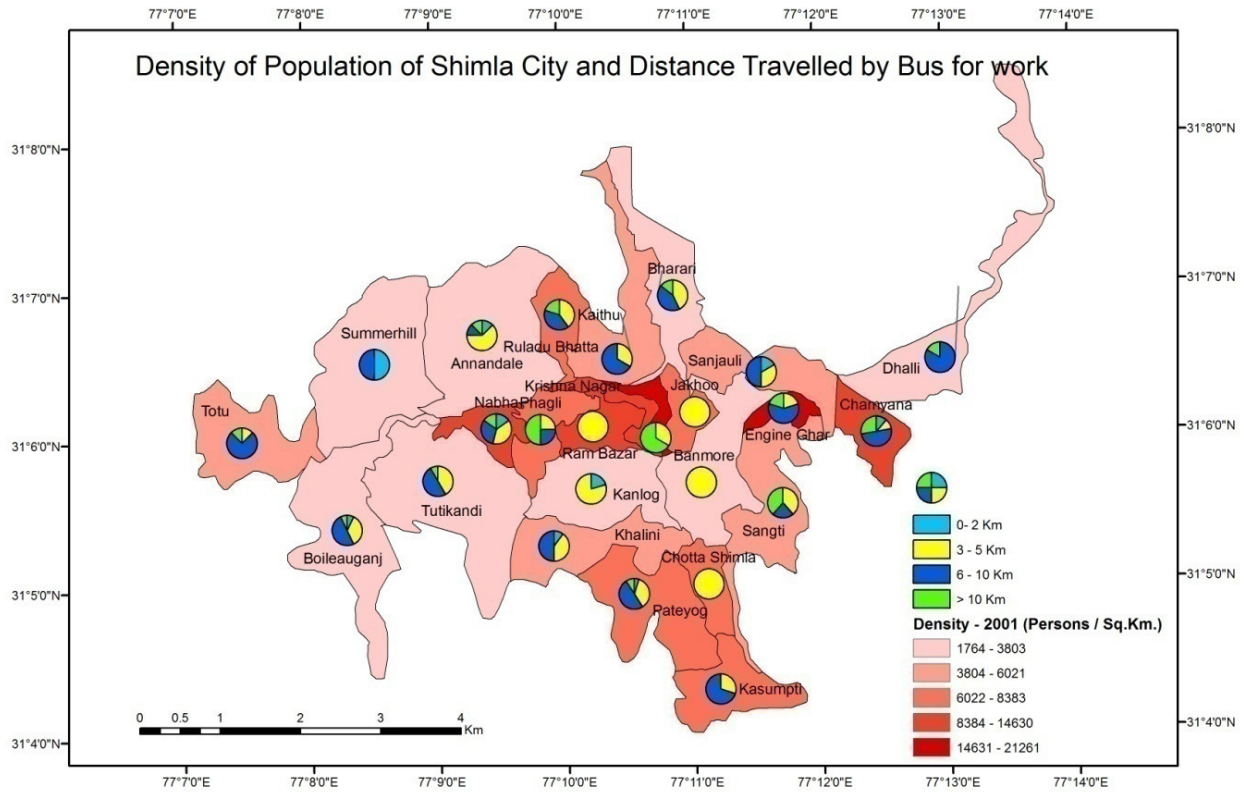
Movement of people to various distances on foot and their relationship with the density of wards

The majority of people go on foot, covering a distance of 2 km. It suggests that most workplaces are situated near residences, especially in core areas where wards such as Ruladu Bhatta, Krishna Nagar, Mall Road, and Ram Bazar people cover short distances. Table 6 shows the ward-wise percentage of people going to work on foot at various distances. Map 5 shows a relationship between the density

Table 5: Wardwise percentage of people going to work by bus to various distances

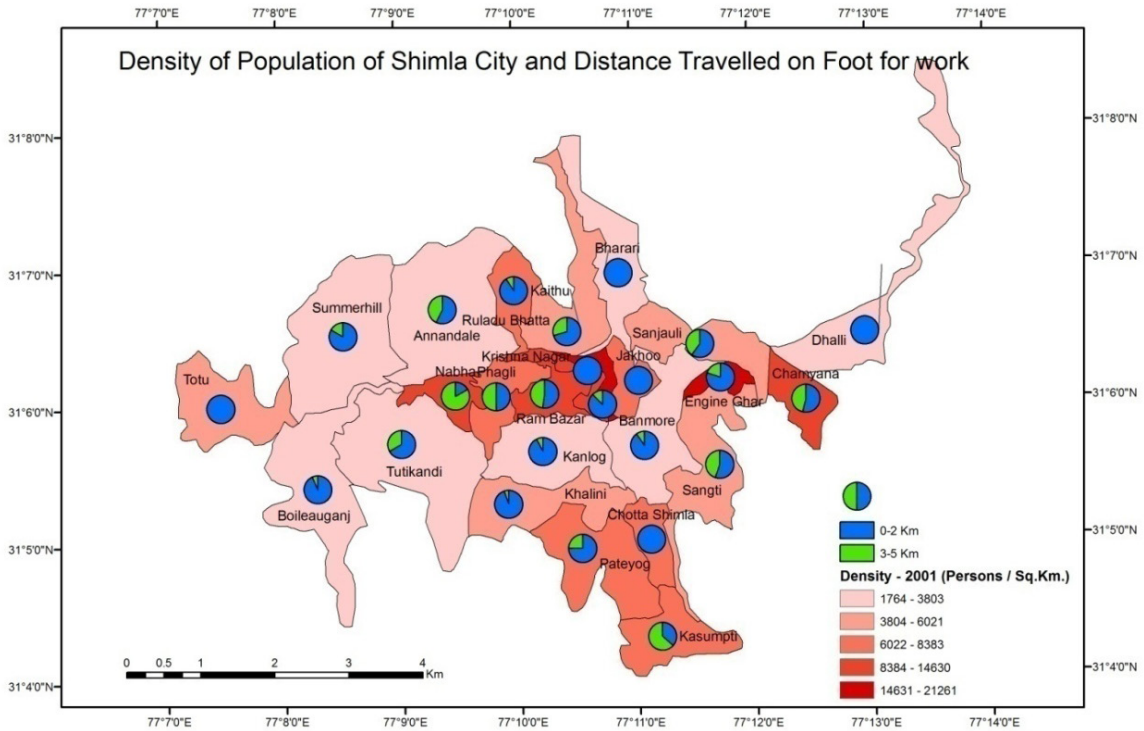
Ward	*Bus*				
	0–2 km	*3–5 km*	*6–10 km*	*> 10 km*	*Total*
Bharari	0	12	12	4	28
Ruladu Bhatta	0	3	6	0	10
Kaithu	0	10	10	5	25
Annandale	4	22	4	4	35
Summerhill	8	0	8	0	16
Totu	0	3	20	3	27
Boileauganj	2	12	17	2	34
Tutikandi	0	28	33	6	67
Nabha	10	25	20	10	65
Phagli	0	5	5	10	20
Krishna Nagar	0	18	0	0	18
Ram Bazar	0	0	0	0	0
Mall Road	0	5	0	11	16
Jakhoo	0	29	0	0	29
Banmore	0	7	0	0	7
Engine Ghar	0	6	19	6	31
Sanjauli	5	11	16	0	32
Dhalli	0	0	24	5	29
Chamyana	5	5	24	14	49
Sangti	0	20	12	20	52
Kasumpti	0	9	22	0	31
Chotta Shimla	0	20	0	0	20
Pateyog	2	18	24	4	49
Khalini	3	12	15	0	30
Kanlog	5	18	0	0	23

Source: Based on primary data collected by the researcher during 2010-11



Source: Based on primary data collected by the researcher during 2010-11

Map 4: Density of population of Shimla city and distance travelled by bus for work



Source: Based on primary data collected by the researcher during 2010-11

Map 5: Density of population of Shimla city and distance travelled on foot for work

Table 6: Ward-wise percentage of people going to work on foot at various distances

Ward	*On Foot*		
	0–2 Km	*3–5 Km*	*Total*
Bharari	56	0	56
Ruladu Bhatta	61	26	87
Kaithu	50	5	55
Annandale	17	13	30
Summerhill	40	8	48
Totu	33	0	33
Boileauganj	34	2	37
Tutikandi	11	6	17
Nabha	5	25	30
Phagli	30	30	60
Krishna Nagar	43	39	82
Ram Bazar	100	0	100
Mall Road	74	11	84
Jakhoo	71	0	71
Banmore	60	7	67
Engine Ghar	25	6	31
Sanjauli	32	21	53
Dhalli	57	0	57
Chamyana	19	16	35
Sangti	20	16	36
Kasumpti	13	22	34
Chotta Shimla	67	0	67
Pateyog	20	7	27
Khalini	52	3	55
Kanlog	55	5	60

Source: Based on primary data collected by the researcher during 2010-11

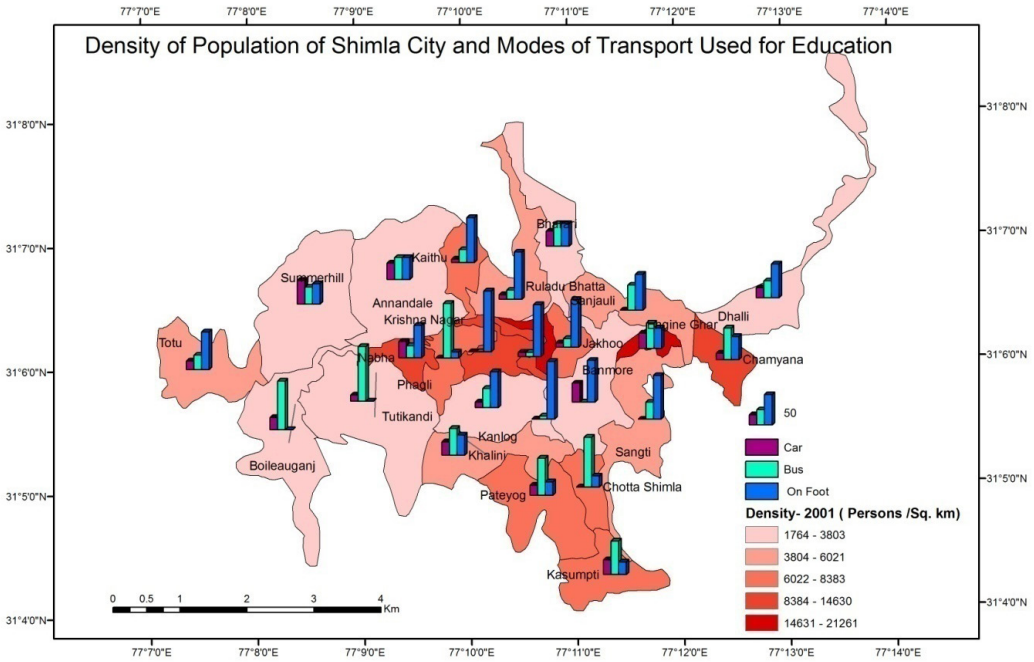
of the population of Shimla city and the distance traveled on foot for work.

Movement of students to various distances by various modes and their relationship with the density of wards

Students cover longer distances by cars or buses. Maximum use of cars is seen in Annandale, Summerhill, Banmore and Nabha. Whereas in Boileauganj, Tutikandi, Phagli, and Chota Shimla buses are used. People mostly walk in central wards such as Krishna Nagar, Mall Road, Ram Bazar, and Jakhoo. Table 7 presents the wardwise percentage of students moving to various distances by different modes. This is related to the density. Map 6 presents the density of the population of Shimla city and modes of transport used for education. Similarly, Maps 7, 8 and 9 represent a relationship between the density of the population of Shimla city and the distance traveled by car, bus, and on foot for education, respectively.

Mixed land-use

Urban structure and 'built environment have a direct impact on the scope of travel (e.g., vehicle miles traveled, vehicle hours traveled, travel frequency) and on mode choice (walking, cycling, using the private car, or riding transit)' (Leck 2006: 38). According to Nozzi (2003 cf. Arbury 2005: 27), using the private mode of travel has become a necessity as there is 'no other way to transport children, groceries, and conduct other multi-destination activities, with the convenience of the 'always available' car'. A lack of public space identifies a 'sprawled' community as Gillham (2002: 7 cf. Arbury 2005: 27) defines it to be 'an unbroken fabric of



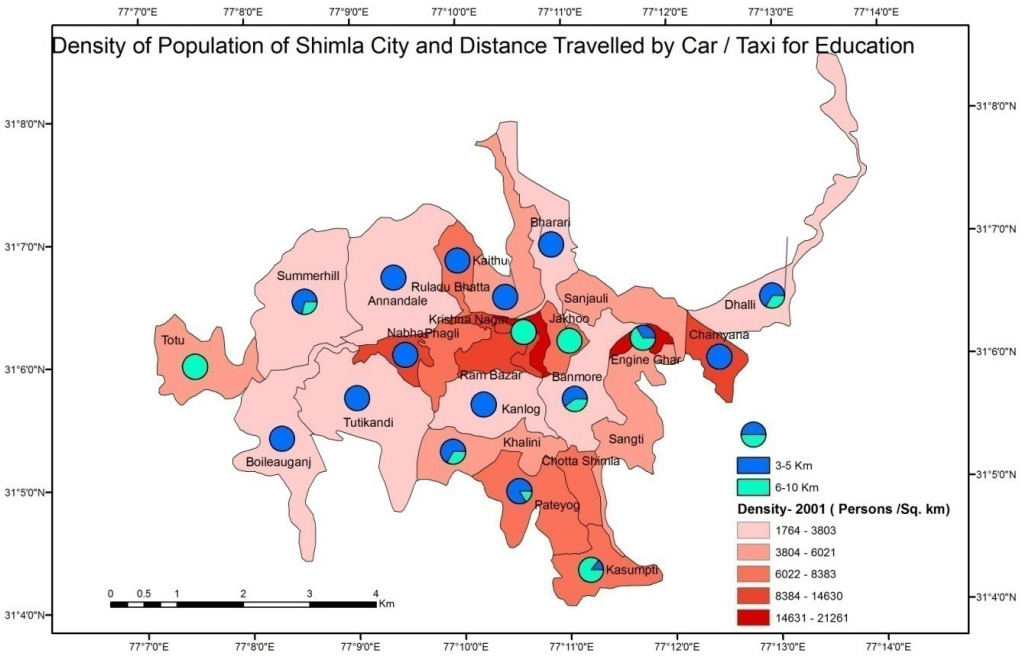
Source: Based on primary data collected by the researcher during 2010-11

Map 6: Density of population of Shimla city and modes of transport used for education

Table 7: Wardwise percentage of students moving to various distances

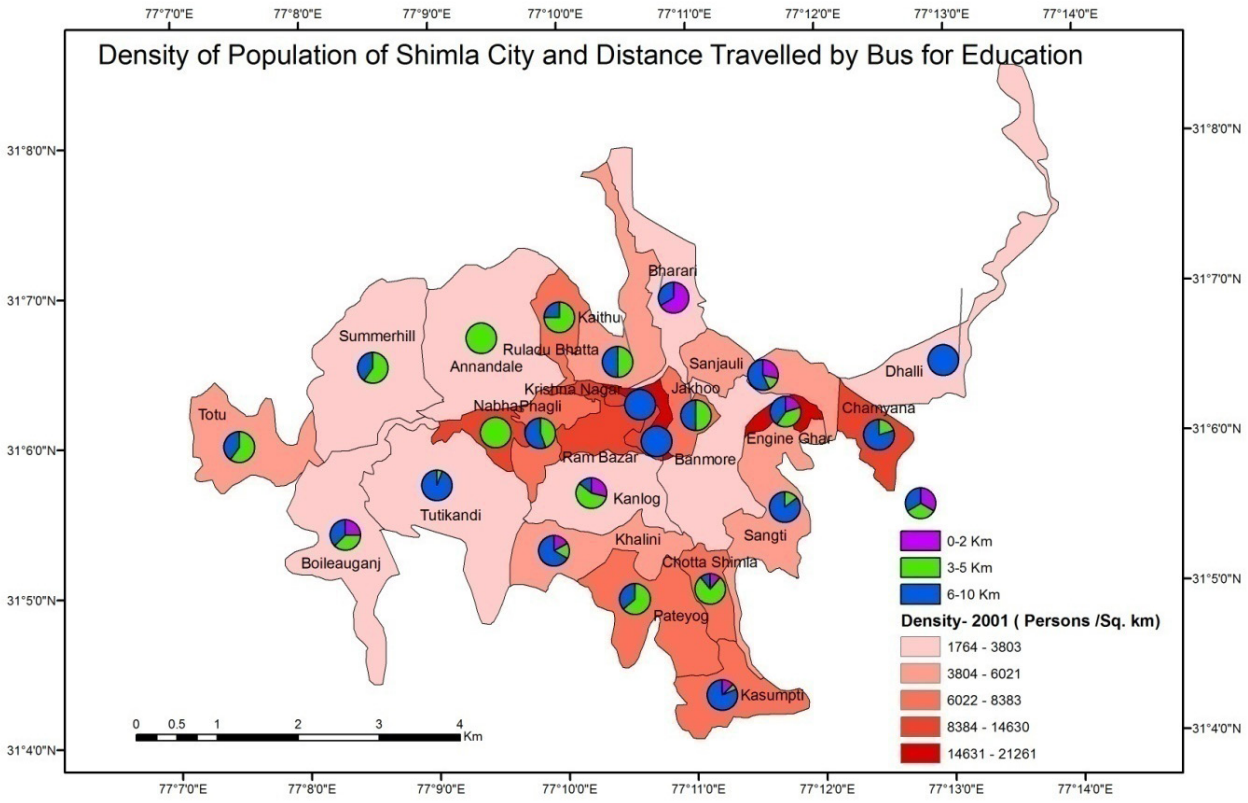
Education	*Car*			*Bus*				*On foot*		
Ward	*3–5 km*	*6–10 km*	*Total*	*0–2 km*	*3–5 km*	*6–10 km*	*Total*	*0–2 km*	*3–5 Km*	*Total*
Bharari	25	0	25	25	0	13	38	38	0	38
Ruladu Bhatta	7	0	7	0	7	7	15	63	15	78
Kaithu	5	0	5	0	16	5	21	37	37	74
Annandale	27	0	27	0	36	0	36	27	9	36
Summerhill	28	11	39	0	17	11	28	33	0	33
Totu	0	14	14	0	14	10	24	62	0	62
Boileauganj	20	0	20	20	30	30	80	0	0	0
Tutikandi	10	0	10	0	5	85	90	0	0	0
Nabha	27	0	27	0	20	0	20	40	13	53
Phagli	0	0	0	0	40	50	90	0	10	10
Krishna Nagar	0	0	0	0	0	0	0	67	33	100
Ram Bazar	0	7	7	0	0	7	7	79	7	86
Mall Road	0	0	0	0	0	5	5	55	40	95
Jakhoo	0	7	7	0	7	7	14	57	21	79
Banmore	19	13	31	0	0	0	0	25	44	69
Engine Ghar	8	17	25	8	17	17	42	33	0	33
Sanjauli	0	0	0	12	6	24	41	53	6	59
Dhalli	11	6	17	0	0	28	28	44	11	56
Chamyana	10	0	10	0	10	41	52	34	3	38
Sangti	0	0	0	0	4	24	28	48	24	72
Kasumpti	3	21	24	7	3	45	55	14	7	21
Chotta Shimla	0	0	0	9	64	9	82	18	0	18
Pateyog	14	3	17	0	39	22	61	22	0	22
Khalini	15	7	22	7	7	30	44	33	0	33
Kanlog	9	0	9	9	18	5	32	27	32	59

Source: Based on primary data collected by the researcher during 2010-11



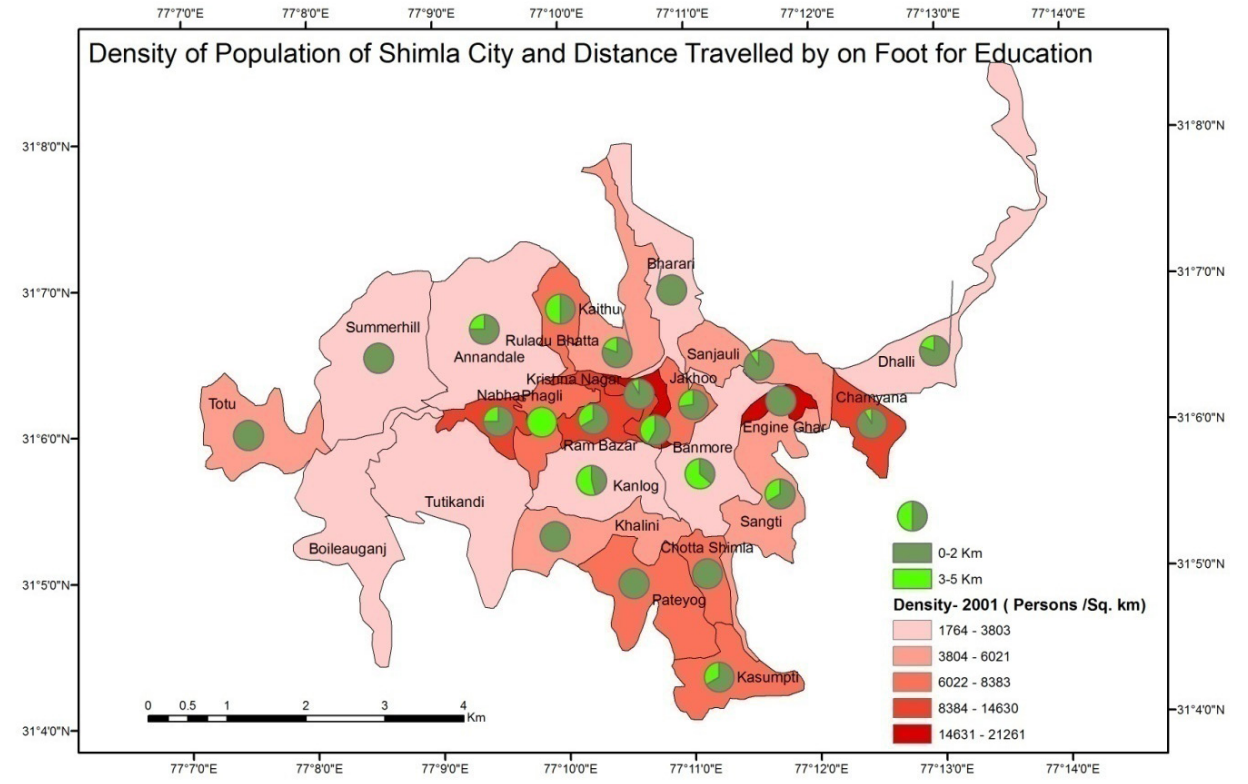
Source: Based on primary data collected by the researcher during 2010-11

Map 7: Density of population of Shimla city and distance travelled by car for education



Source: Based on primary data collected by the researcher during 2010-11

Map 8: Density of population of Shimla city and distance traveled by bus for education



Source: Based on primary data collected by the researcher during 2010-11

Map 9: Density of population of Shimla city and distance travelled on foot for education

Table 8: Ward-wise percentage of people travelling for various purposes to short distances (< 2 km)

Work	*up to 2 km*	*Education*	*up to 2 km*	*Daily needs*	*up to 2 km*	*Chemists*	*up to 2 km*
Ram Bazar	100	Ram Bazar	78.6	Bharari	100	Summerhill	100
Mall Road	75	Ruladu Bhatta	70.4	Annandale	100	Tutikandi	100
Jakhoo	71.5	Krishna Nagar	66.7	Summerhill	100	Nabha	100
Banmore	66.7	Sanjauli	64.7	Totu	100	Ram Bazar	100
Chotta Shimla	66.6	Bharari	62.5	Boileauganj	100	Mall Road	100
Summerhill	64	Totu	61.9	Tutikandi	100	Jakhoo	100
Ruladu Bhatta	61.3	Nabha	60	Nabha	100	Engine Ghar	100
Kanlog	59.1	Jakhoo	57.1	Phagli	100	Sanjauli	100
Khalini	57.5	Mall Road	55	Krishna Nagar	100	Kasumpti	100
Dhalli	57.1	Summerhill	50	Ram Bazar	100	ChottaShimla	100
Bharari	56	Sangti	48	Mall Road	100	Kaithu	100
Kaithu	50	Dhalli	44.4	Jakhoo	100	Boileauganj	100
Krishna Nagar	42.8	Kaithu	42.1	Engine Ghar	100	Totu	95.83
Sanjauli	42.1	Engine Ghar	41.6	Dhalli	100	Sangti	95.45
Totu	36.7	Kanlog	40.9	Kasumpti	100	Khalini	95.00
Boileauganj	36.6	Khalini	40.7	Chotta Shimla	100	Krishna Nagar	93.33
Phagli	30	Chamyana	34.5	Pateyog	100	Ruladu Bhatta	88.89
Engine Ghar	25.1	Banmore	31.3	Khalini	100	Chamyana	86.96
Chamyana	24.3	Annandale	27.3	Kanlog	100	Dhalli	86.67
Pateyog	22.3	Chotta Shimla	27.3	Ruladu Bhatta	100	Phagli	83.33
Annandale	21.7	Pateyog	21.6	Kaithu	100	Pateyog	79.41
Sangti	20	Kasumpti	20.6	Chamyana	95.65	Kanlog	78.57
Nabha	15	Boileauganj	20	Sanjauli	93.33	Bharari	72.73
Kasumpti	12.5	Tutikandi	0	Sangti	90.91	Annandale	71.43
Tutikandi	11.1	Phagli	0	Banmore	76.92	Banmore	46.15

Source: Based on primary data collected by the researcher during 2010-11

privately owned land divided only by public roads.' Travel distance also depends on the location of activities as has been identified by Geurs and Van Wee (2004:128) that land use, transportation, temporal and individual affect it. Various scholars have recognized that compact cities reduce pollution and save energy and various organizations have operationalized this concept, such as the European Commission 1990, the UK and Dutch government, etc. (Breheny 1995:81). In the United Kingdom, two major governments initiatives were taken in 1993-1994 i.e., the UK Strategy for sustainable development and the Planning Policy Guidance note PPG13 for taking measures to reduce the need to travel (*ibid,* 1995:83). Higher density areas reduce the need for travel and further consumption of fuel as has been studied by Newman and Kenworthy (Breheny 1995:84).

Table 8 represents a mixed land use and reduced need for transport. For work except for Totu, Boileauganj, Phagli, Engine Ghar, Chamyana, Pateyog, Annandale, Sangti, Nabha, Kasumpti and Tutikandi wards, more than 40% of households cover a distance up to 2 Km. Similarly, for education, except for Chamyana, Banmore, Annandale, Chotta Shimla, Pateyog, Kasumpti, Boileauganj, Tutikandi and Phagli wards, more than 40% cover a distance up to 2 Km. For more than 90% of households, daily needs shops are available up to a distance of 2 Km. Only in Banmore ward around 23% have to move to a distance of more than 2 Km. For chemists, except for Banmore ward, 70% of the households have this facility available up to 2 Km. It suggests that mixed land use promotes a reduced need for transport.

Accessible and efficient transport (to work, education, public space, etc.)

- *Maximum use of public transport*

Public transport is more efficient as compared to private transport as it consumes less energy and pollutes less. More car accidents suggest that public transport is safer than private. It depends on the quality of infrastructure and availability of modes of transport that decide peoples' preference. In European countries, short trips are made by bicycle and the government has subsidized and given incentives to users. In 1976 the Dutch government tried to design low-speed residential roads and formalized the

approach, defining the concept of the woonerf (roughly translated as 'yard for living') (Hamilton-Baillie 2008:167), but the concept was not successful. The United Kingdom, Denmark, Sweden, Germany and the Netherlands have seen numerous cities and towns redesign neighborhood streets to create 'home zones' or 'woonerfs'—areas where cars, bicyclists, and pedestrians coexist on equal terms (Hamilton-Baillie 2002 cf. Goldman and Gorham 2006:273). Such designs not only make urban landscapes more pleasing but also improve the safety of pedestrians and encourage social interaction in public spaces (*ibid,* 2006:273).

The needs of pedestrians (more walkability) are important during the planning

The needs of different income groups are not only different but also conflicting. Pedestrians should be encouraged in the city to reduce pollution and improve the health of people. Also, infrastructure creation and division of space for use by people of different strata should be done at the planning and policy-making stage. Space for pedestrians and cyclists was not given much importance while infrastructure designing for Shimla. Though some pedestrians were there in the central part of the city around the cart road in the initial planning and later on some new pedestrians were added under the smart city project, keeping in view a large percentage of people, i.e., more than 50% walk for everyday activities like work and education.

Conclusion and Suggestions

Community support for a change of lifestyle is very crucial and should be encouraged. Also, with technological support, comfortable, safe and smooth transport can be maintained. Behavioral changes include more use of environment-friendly walking trips, combined trips and public transport rather than the use of private vehicles. This will help in reducing pollution and augment better quality of life in cities. Technological solutions include the use of energy-efficient vehicles and the development of a safe and feasible public transportation system. The mitigating effects of new technologies tend to be overshadowed by the continuing growth of car use (Steg and Gifford 2005:59) and drivers might even be tempted to use their energy-efficient car more often because it is cheaper and more environmentally friendly. This phenomenon is referred to as the rebound effect (Berkhout *et al*., 2000) or the Jevons principle (OECD, 1996). It is up to the people whether they adopt behavioral changes over technological changes. Generally, people are reluctant to behavioral changes as they find them to be curtailing their freedom, convenience and comfort (Poortinga *et al*., 2003).

Shimla's situation suggests a mixed land use mostly in the core area and its surroundings. Density is high and the majority of trips are walk trips. Further densification cannot be done as Shimla is already facing problems of water shortage, traffic and congestion, etc. With its geological and topographical fragility, land is a precious resource and its use should be restricted and done judicially. Recent catastrophes have raised an alarm that more resilient technologies and infrastructures are required for Shimla. However, it can be fitted into a compact city model with respect to density and trip length criteria, which is sustainable with a few behavioral and lifestyle changes and government efforts. Mixed land use also reduces the need for transport. The majority of trips are up to a distance of 2 km, which further confirms the compact city model. Hence, with the two selected criteria, i.e., density and travel distance, Shimla complies with a compact city model.

Author Contribution Statement

This paper has been written under the guidance of my research supervisor, Dr. Geetam Tiwari, Head of the Department of Civil Engineering and Design, Indian Institute of Technology Delhi, India. Under her guidance, the concept was designed and various interpretations and analyses were done.

Data Availability Statement

The Ward map of Shimla was procured from the office of The census of India Himachal Pradesh Shimla for the year 2001. The figures for the population of Shimla Municipal Corporation were downloaded from the official website of the census of India https://censusindia.gov.in/census.website/. Mapwork and analysis are based on primary household survey data of city residents collected by the researcher.

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