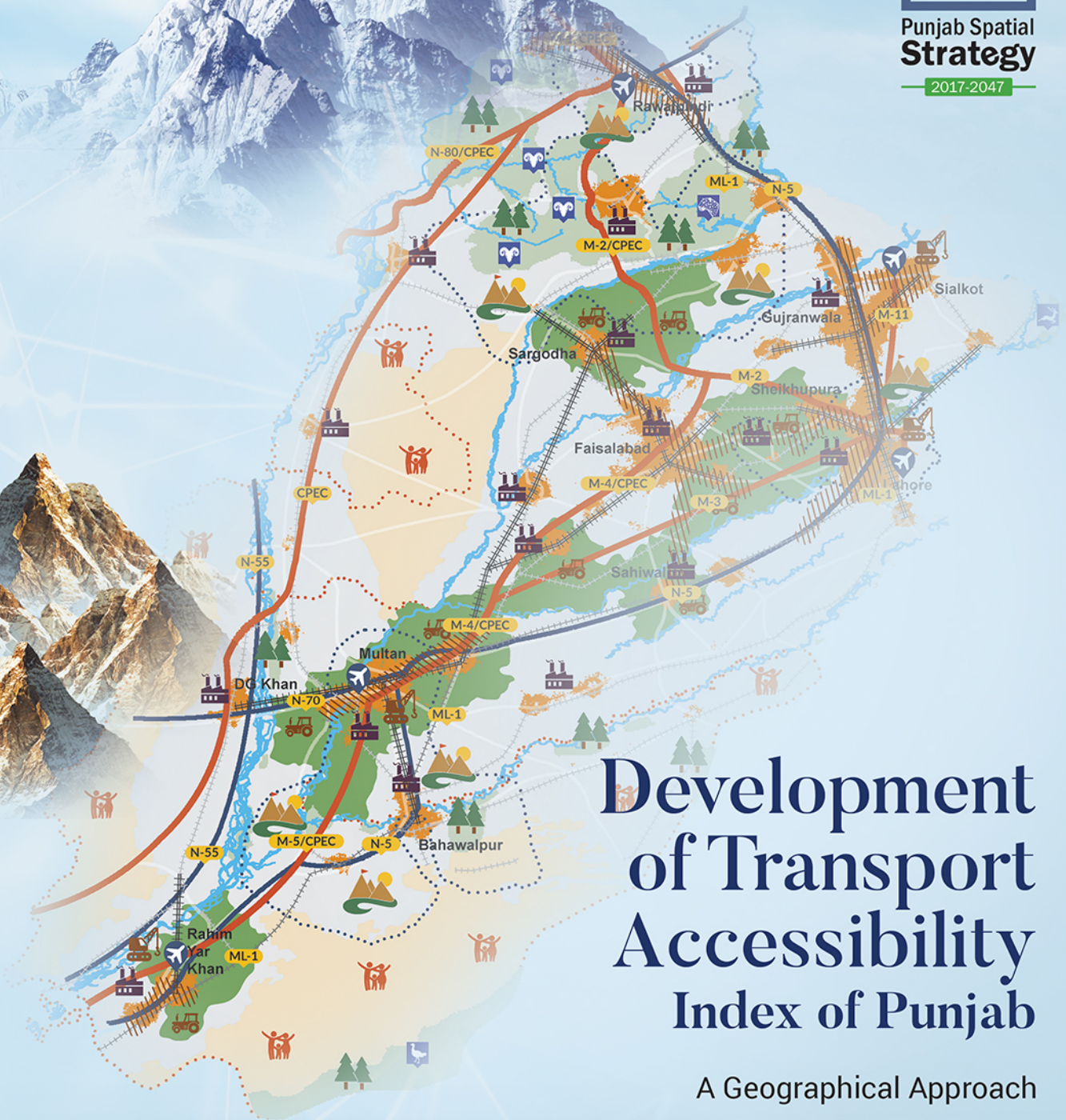




Punjab Spatial  
**Strategy**

2017-2047



# Development of Transport Accessibility Index of Punjab

A Geographical Approach



**The Urban Unit**  
Urban Sector Planning & Management Services Unit (Pvt.) Ltd.



## **DISCLAIMER**

This accessibility index document is meant to serve as a guidance note for Districts/ Cities/ Metropolitan and Transport Authorities in Punjab for implementation of Public Transport infrastructure within their jurisdiction.

All legally prevalent procedures shall be followed, and all approvals/sanctions sought as per law shall be sorted while preparing PC-1, approval and tender documents and soliciting approval prior to construction/ implementation.

**PREPARED BY:**

1. Dr. Syed Murtaza Asghar Bukhari  
Sr. Specialist - Transport Planning & Management
2. Mr. Zuhair Aslam  
Senior Research Analyst - Transport Planning & Management
3. Mr. Muhammad Bilal  
Research Analyst - Transport Planning & Management

**REVIEWED BY:**

1. Dr. Nasir Javed  
Chief Executive Officer - The Urban Unit

## Contents

1	INTRODUCTION.....	7
1.1	Social Exclusion and Transport.....	7
1.2	The Case of Punjab .....	8
1.2.1	Road Length in KMs by Type under NHA and Highway Department - Punjab.....	9
2	OBJECTIVES.....	9
3	METHODOLOGY .....	9
3.1	Data Collection.....	11
3.1.1	Settlement Unit under Analysis .....	11
3.1.2	Availability of Public Transport .....	12
3.1.3	Distance to Key Services .....	14
3.1.4	Data Sets .....	15
3.2	Calculation of Accessibility Scores.....	15
3.2.1	Access to Public Transport .....	15
3.2.2	Bus Stops .....	15
3.2.3	Bus Terminals .....	16
3.2.4	Railway Stations .....	16
3.2.5	Airports .....	16
3.2.6	Summary .....	16
3.2.7	Proximity to Service Centre Score.....	18
4	ACCESSIBILITY INDEX .....	21
4.1.1	Criteria 1 .....	21
4.1.2	Scenario 2: .....	22
4.1.3	Scenario 3.....	24
4.1.4	Criteria 2 .....	25
4.1.5	Scenario 2.....	26
4.1.6	Scenario 3.....	27
5	CONCLUSIONS AND RECOMMENDATIONS.....	28

## List of Figures

Figure 1: Detailed Methodology.....	10
Figure 2: Population Density of Districts .....	11
Figure 3: Population Density of Tehsils .....	12
Figure 4: Location of Bus Stops .....	13
Figure 5: Location of Bus Terminals .....	13
Figure 6: Location of Airports .....	14
Figure 7: Location of Railway Stations .....	14
Figure 8: Accessibility to Bus Terminals.....	17
Figure 9: Accessibility to the Bus Stops.....	17
Figure 10: Accessibility to Airports.....	17
Figure 11: Accessibility to Railway Stations.....	17
Figure 12: Drive Time to the Districts of Population 1.5-2.5M .....	20
Figure 13: Drive Time to the Districts of Population <1.5M .....	20
Figure 14: Drive Time to the Districts of Population >4.5M .....	20
Figure 15: Drive Time to the Districts of Population 2.5-4.5M .....	20
Figure 16: Accessibility Index for Punjab (Bus Stops Only) .....	22
Figure 17: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations Only)..	23
Figure 18: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations & Airports).....	24
Figure 19: Accessibility Index for Punjab (Bus Stops Only) .....	25
Figure 20: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations Only)..	26
Figure 21: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations & Airports).....	27

## List of Tables

Table 1: Road Length in KMs by Type under NHA and Highway Department - Punjab.....	9
Table 2: Data Sets Collected for Analysis .....	15
Table 3: Summary of Scoring used for Access to Public Transport.....	16
Table 4: Summary of Scoring used for Proximity to Service Centers (District Centers).....	18
Table 5: Summary of Scoring used for Proximity to Service Centers (POIs).....	19
Table 6: Accessibility Index Score of Punjab Tehsils-Scenario 1 .....	21
Table 7: Accessibility Index Score of Punjab Tehsils-Scenario 2 .....	22
Table 8: Accessibility Index Score of Punjab Tehsils-Scenario 3 .....	24
Table 9: Accessibility Index Score of Punjab Tehsils-Scenario 1 .....	25
Table 10: Accessibility Index Score of Punjab Tehsils-Scenario 2 .....	26
Table 11: Accessibility Index Score of Punjab Tehsils-Scenario 3 .....	27

# Punjab Public Transport Accessibility Index

## 1 INTRODUCTION

Transportation is a non-separable part of any society which exhibits a very close relation to the style of life, the range and location of activities, the goods and services which are available for consumption. Advancements in transportation including planning and rolling stock has made plausible changes in the way of living and organization of social networks in the society; thus, it has a great influence in the development of communities.

Undoubtedly, transportation has been an important factor in development and prosperity of civilizations historically. It is because it has always played an important role in influencing the formation of communities. Although other facilities like availability of food and water, etc., has also been a major factor, yet the role and contribution of transportation is evident from the formation, size and pattern of societies, especially urban centers. Previously, a decade ago the social impedances of transport and their distributional effects across various segments of society was considered a secondary or even tertiary concerns relative to the economic and environmental impacts; however, during the last decade transport has emerged as a key contributor in inclusion or exclusion of social groups in a society. Identifying the relative lack of academic and policy attention in this area in developing cities where local governments are making huge investments with respect to transport service provision especially in shape of mass transit network out of government exchequer pockets, there is a dire need to critically evaluate the social impacts of transport disadvantage, and study the wider interactions among poverty, transport disparity and social exclusion.

Originally, the purpose of the study was to develop public transport deprivation index for Punjab but due to limitations of data, resources and time the objectives were confined to the development of accessibility index for public transport in Punjab which could later be used with measures of deprivation to determine transport deprivation index.

### 1.1 Social Exclusion and Transport

People need transport to reach activities; but in fact, these are locations which are connected by the transport network as people originate their journey from one location i.e., house, job, etc. to other location i.e., house, shopping center, etc. (Moseley, 1979; Jong et al., 1996). The interaction of the driver, transport and road creates a traffic environment which has a psychological and social relationship with both the local environment and society. This relationship can induce much stress and society has a responsibility to provide an adequate transport system which reduces stress and conflict as much as possible (Gunnarsson et al., 1990).

The issue of the interaction of location and travel is central to community design, urban economics, and regional planning (Levinson et al., 2005). Integration of land use and transport is a key policy

objective which has directed towards the implementation of new techniques and procedures to measure accessibility which is difficult to achieve (Hine et al., 2000a; Halden, 2002). The debate of integration of land use and transport has highlighted important phenomenal terms like social exclusion, transport poverty or transport disparity.

## **1.2 The Case of Punjab**

Punjab is Pakistan's second largest province with an area of 205,344 square kilometers (79,284 square miles) (SMEDA). Punjab has the largest economy in Pakistan, contributing most to the national GDP. The province's economy has quadrupled since 1972. Its share of Pakistan's GDP was 54.7% in 2000 and 59% as of 2010. The economy of Punjab is dominated by agriculture sector while industry and services sector are the emerging sectors contributing in people prosperity. Lahore is not only the provincial capital but is also the largest city of province with an estimated population of 10 million. Other important cities include Faisalabad, Rawalpindi, Gujranwala, Sargodha, Multan etc. These cities are connected by multiple networks of roadways including motorway, national and provincial highway, farm to market roads, etc. Table 1 below highlights the length of various roads in Punjab.

Identical to most of the other developing countries in the world, the prime focus of the government entities in Punjab, Pakistan has remained on the construction of roads in previous decades. This, on one hand improved accessibility of the rural areas but on the other hand has led to rapid urbanization of the cities. The situation is further deteriorated by steady increasing population. People belonging to rural areas immigrated to urban center preferably major cities Lahore, Faisalabad and Rawalpindi in North and to Multan in South of Punjab for better health and education facilities. Apart from these migrations, the number of daily commuters from the surrounding towns and villages to these cities has also increased steadily. More and more people now daily commute to these cities even on two wheelers to access employment, health and education, etc. facilities. Consequently, the intra city transport system of these urban centers have choked down and city residents observe congestion every day. Significant increase in motorized mobility in the last few years has brought congestion on the roads of urban areas of Punjab. Due to the congestion, livable conditions have severely deteriorated. Therefore, there is a dire need of accessibility and mobility evaluation and to undertake pragmatic examination of the prevailing public transport network in Punjab to identify the potential corridors for future investments.

The purpose of developing this index is to provide a valid input in determining relative accessibility which can be used for future planning, needs assessment and future transportation requirements at tehsil and district level.

### 1.2.1 Road Length in KMs by Type under National Highway Authority and Highway Department, Punjab (Punjab Development Statistics, 2015)

The details are mentioned below table.

**Table 1: Road Length in KMs by Type under NHA and Highway Department - Punjab**

Year	Total Road* Length	High Type					Motorways	Low Type Roads
		National Highway	Provincial Road	District Council Roads	Farm to Market Roads	Sugar Cess Roads		
2004-05	69799	1610	14630	13521	36138	3188	387	325
2005-06	71010	1610	14630	14132	36620	3306	387	325
2006-07	71010	1610	14630	14132	36620	3306	387	325
2007-08	72240	1610	14526	14448	37625	3319	387	325
2008-09	74422	1610	14962	14735	39030	3373	387	325
2009-10	74422	1610	14962	14735	39030	3373	387	325
2010-11	74422	1610	14962	14735	39030	3373	387	325
2011-12	75850	1610	16390	14735	39030	3373	387	325
2012-13	75850	1610	16390	14735	39030	3373	387	325
2013-14	76245	1610	16785	14735	39030	3373	387	325

*\*Includes 334 Kilometers of Lahore-Islamabad Motorway and 53 Kilometers of Pindi Bhattian-Faisalabad Motorway*

## 2 OBJECTIVES

Various approaches and methodologies are used to determine the accessibility index of public transport across a region. But, there is need to develop simpler methodology to highlight the transport access deprived areas across the Province Punjab. Therefore, this study's key objectives are as follows:

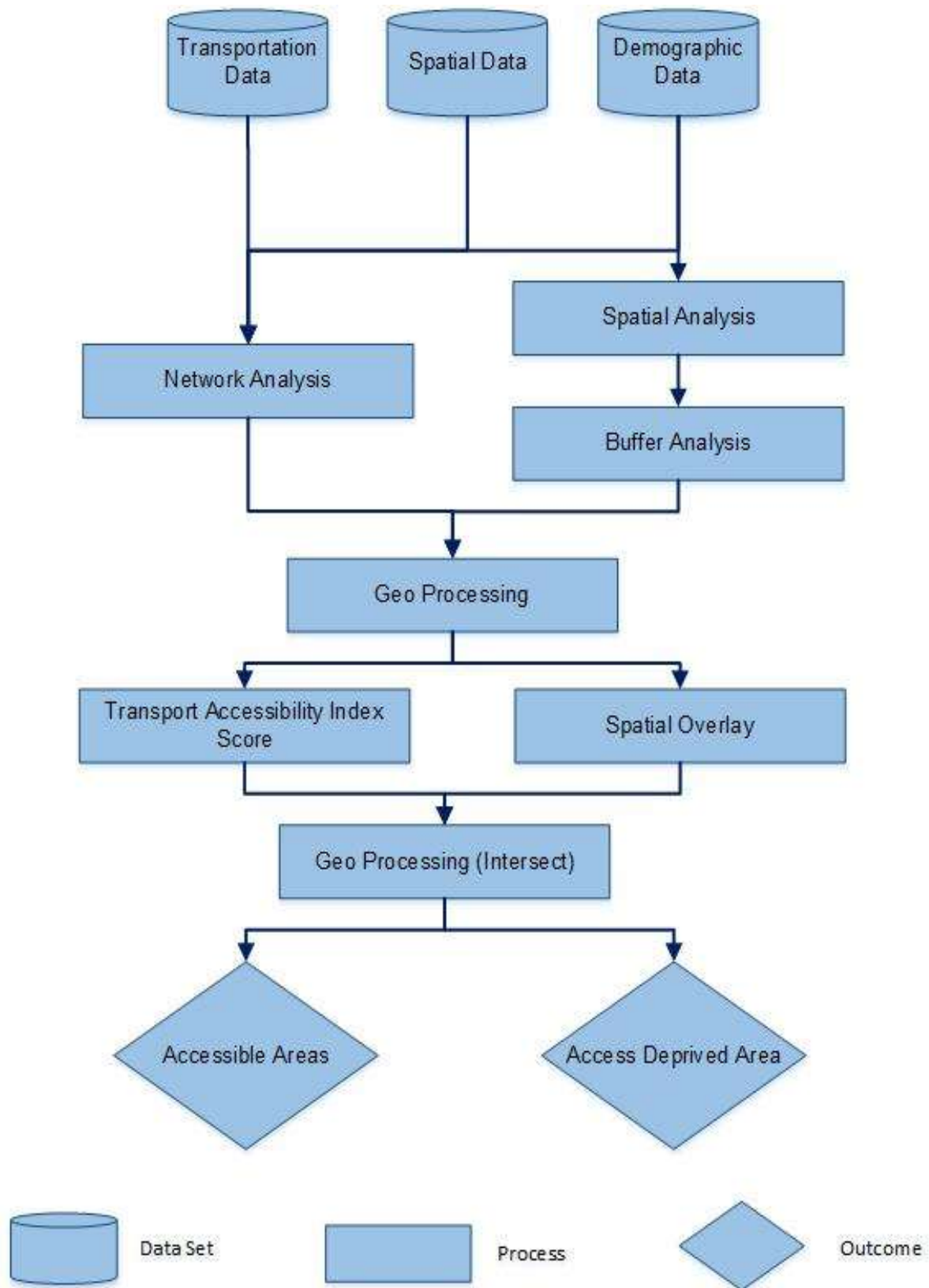
- To identify an effective and relatively simpler methodology to assess accessibility of public transport at tehsil level.
- Application of methodology to analyze the accessibility and provide the results in both tabular and mapped form.
- To identify the potential future improvements in the methodology and index.

## 3 METHODOLOGY

The methodology adopted can be classified into four steps

- 1) Gathering of Data for Input to Analysis
- 2) Calculating Scores
- 3) Creating Indices using scores

Following is the flow chart of methodology adopted for this study.



**Figure 1: Detailed Methodology**

### 3.1 Data Collection

#### 3.1.1 Settlement Unit under Analysis

Tehsils were considered to be the settlement unit through which populace catchment area is to be analyzed. The area consideration is Punjab which is most densely populated province of Pakistan. It entails 36 districts and 09 divisions are its constituent units. Every district has a unique population and road network.

##### 3.1.1.1 Population Distribution

Population distribution is considered to be homogenous throughout the district so that it could be dealt as a whole unit during analysis and it is also near to reality as in Tehsils homogenous demographics are mostly observed as shown below in the maps of districts and tehsils. Moreover, another assumption about demographic characteristics is that the population considered under the catchment area is considered residential; it's definitely not an essential case but was deemed essential for the study. Paved roads and walkways were considered to be present in the catchment area which again is not an essential case, but deemed inevitable for the analysis.

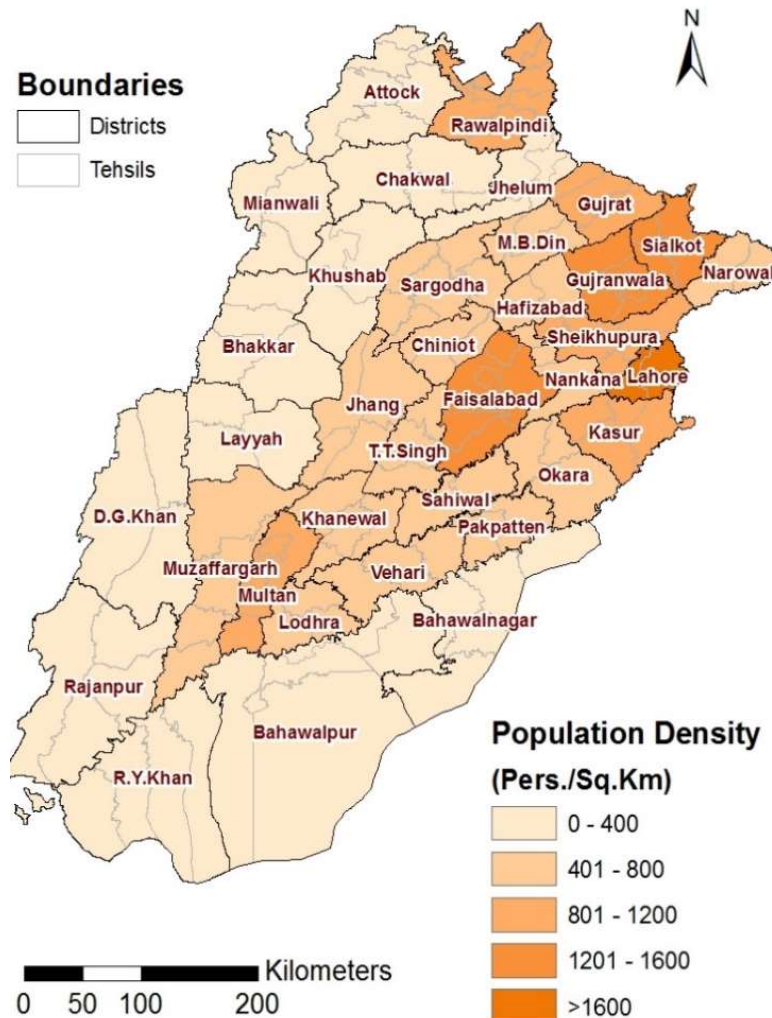
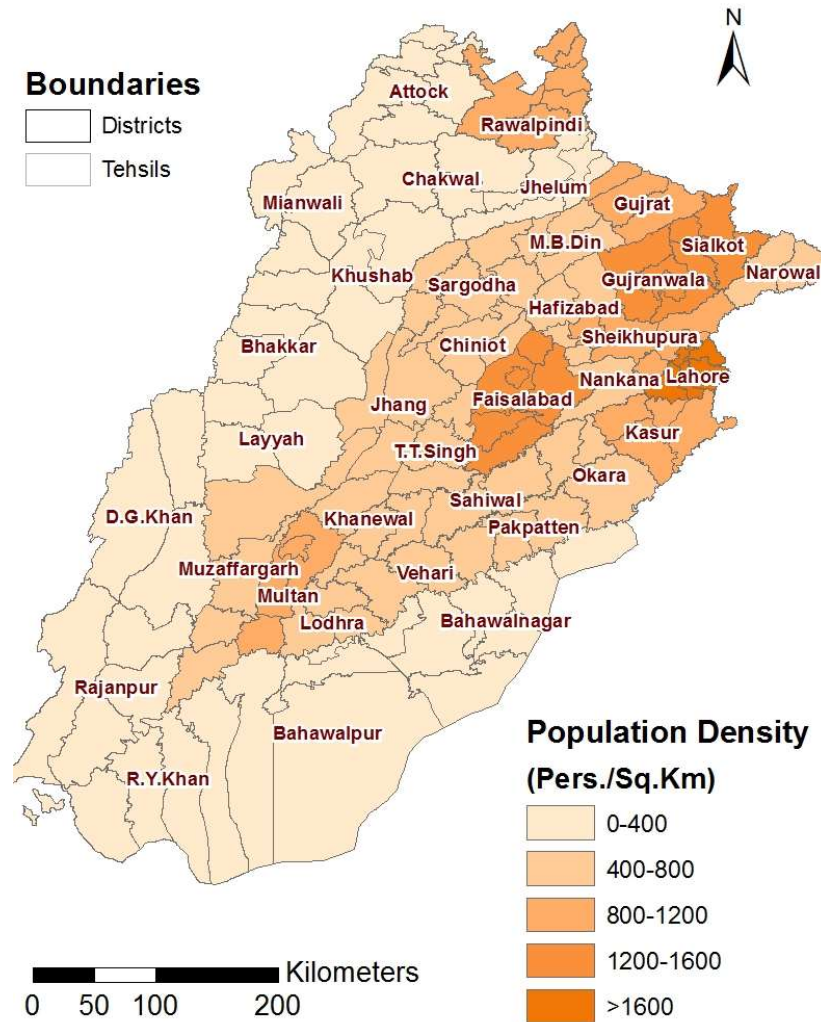


Figure 2: Population Density of Districts



**Figure 3: Population Density of Tehsils**

### 3.1.1.2 Centroids for Tehsils

For each Tehsil on the basis of assumed homogenous demographic characteristics gravitational centroids are considered to calculate service area or the point of action for the analysis.

### 3.1.2 Availability of Public Transport

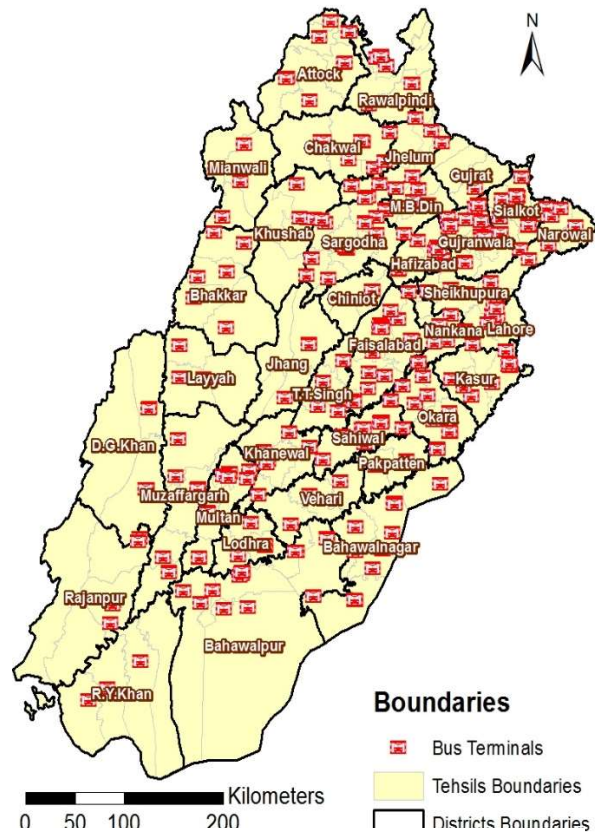
Government run public transport is what usually major chunk of public bus users consist of; moreover, it gives the basic image of the dependability on public transport. Under the study only government buses were considered and no private (allied) systems were considered. As it is time taking and possesses lesser odds of availability of data.

#### 3.1.2.1 Bus Stops and Terminals

Bus stops and terminals of the Government run systems were considered and were taken with highest possible accuracy from the concerned departments and are shown below in the maps.



**Figure 4: Location of Bus Stops**



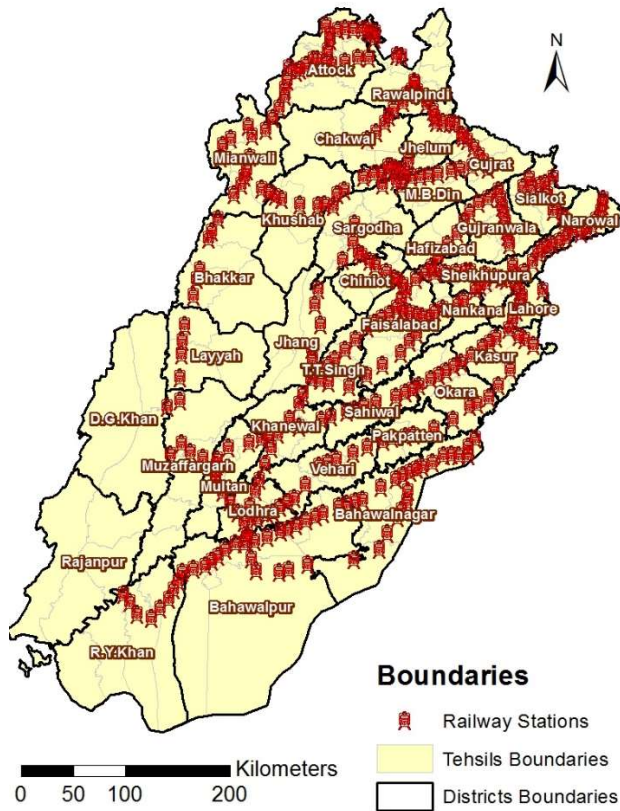
**Figure 5: Location of Bus Terminals**

### 3.1.2.2 Railway Stations

Railway stations were taken with great precise locations and are to be processes under the same analysis as shown below in map.

### 3.1.2.3 Airports

Airports in the province of Punjab were taken from Google Earth and their locations were imported in ArcGIS as shown below in the map.



**Figure 7: Location of Railway Stations**



**Figure 6: Location of Airports**

### 3.1.3 Distance to Key Services

The final parameter to be analyzed and given index is distance to key services. The rationale thought behind it is that the accessibility of a location depends upon its distance from the key services that are necessary for life. Every District contains retail, health and educational facilities which are needed throughout the settlement. It is considered that mostly larger district has the maximum amount of such facilities therefore proximity to the largest district yields greater benefit to a tehsil, also offers availability of better service area and more facilitated population.

#### 3.1.3.1 Categories of Districts

For comparison on various parameters, each district is first categorized based on four levels which were set according the population it holds.

- **Level 1** – Less than 1.5 million persons
- **Level 2** – 1.5 million to 2.5 million persons
- **Level 3** – 2.5 million to 4.5 million persons
- **Level 4** – Over 4.5 million persons

Every Tehsil is scored against the proximity distance to these levels.

### 3.1.4 Data Sets

**Table 2: Data Sets Collected for Analysis**

Data	Attribute	Level/Resolution	Source
Spatial Data	Administrative Boundaries	Districts & Tehsil	The Urban Unit
Demographic Data	Population	Districts & Tehsil	Punjab Development Statistics, 2016
Transport Data	Road Network	Up to Local Roads	Transport planning Unit
	Bus Stop Locations	Operational and Existing Inter-City Bus Stops of Seven Cities	Transport planning Unit
	Bus Terminal Locations	Intra-City Bus Terminals of Punjab	Transport planning Unit
	Railway Station Locations	Existing Railway Stations	Transport planning Unit
	Airport Locations	Existing Operational Airports Locations	Google Earth

## 3.2 Calculation of Accessibility Scores

Tehsil level accessibility scores were given on two basis:

1. Access to Public Transport (Bus stop, Railway Station and Airport)
2. Distance from Service Centre Score

### 3.2.1 Access to Public Transport

The access to public transport score for a Tehsil is calculated by measuring the Tehsil's proximity to a bus stop, railway station and airport.

### 3.2.2 Bus Stops

For Bus stops, a 5 min walk time network buffer was created around every bus stop captured. The proportion of the population of each Tehsil that fell within this area was calculated and the Tehsil received a score as follow;

- 0% of Tehsil's population within area – Score 0
- 1 to 50% of Tehsil's population within area – Score 1
- 50 to 99% of Tehsil's population within area – Score 2
- 100% of Tehsil's population within area – Score 3

### 3.2.3 Bus Terminals

For Bus terminals, a 30-minute off-peak drive time network buffer was created around every terminal captured.

- 0% of Tehsil's population within 30-minute drive time of a terminal – Score 0
- 1 to 50% of Tehsil's population within 30-minute drive time of a terminal – Score 1
- 50 to 99% of Tehsil's population within 30-minute drive time of a terminal – Score 2
- 100% of Tehsil's population within 30-minute drive time of a terminal – Score 3

### 3.2.4 Railway Stations

For Railway stations, a 30-minute off-peak drive time network buffer was created around every railway station captured. The proportion of the population of each Tehsil that fell within this area was calculated and the tehsil received a score as follows;

- 0% of Tehsil's population within 30-minute drive time of a Railway station – Score 0
- 1 to 50% of Tehsil's population within 30-minute drive time of a station – Score 1
- 50 to 99% of Tehsil's population within 30-minute drive time of a station – Score 2
- 100% of Tehsil's population within 30-minute drive time of a railway station – Score 3

### 3.2.5 Airports

For Airports, 1 hour drive time network buffer was created around every airport captured. The proportion of the population of each Tehsil that fell within this area was calculated and the Tehsil received a score as follows;

- 0% of Tehsil's population within area – Score 0
- 1 to 50% of Tehsil's population within area – Score 1
- 50 to 99% of Tehsil's population within area – Score 2
- 100% of Tehsil's population within area – Score 3

### 3.2.6 Summary

In summary, the scoring system is shown in Table 3 below;

**Table 3: Summary of Scoring used for Access to Public Transport**

Percentage of Tehsil's Population	Within 5 min walk time for bus stops	Within 30 min drive time for bus terminals	Within 30 min drive time for railway stations	Within 60 min drive time for airports
0	0	0	0	0
1 to 50	1	1	1	1
50 to 99	2	2	2	2
100	3	3	3	3

Figure 8 – 11 shows the proximity of population to the nearest public transport stops and stations with a color-coded ranges of drive times.

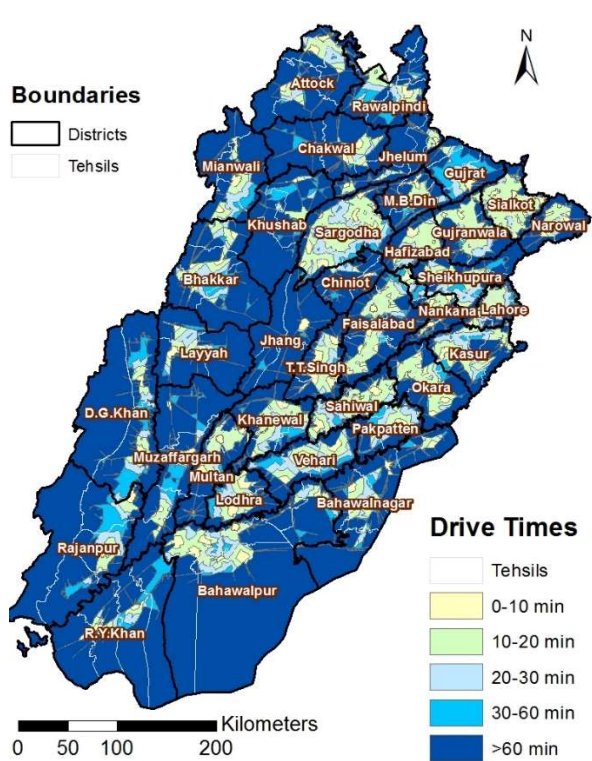


Figure 9: Accessibility to Bus Terminals



Figure 8: Accessibility to the Bus Stops

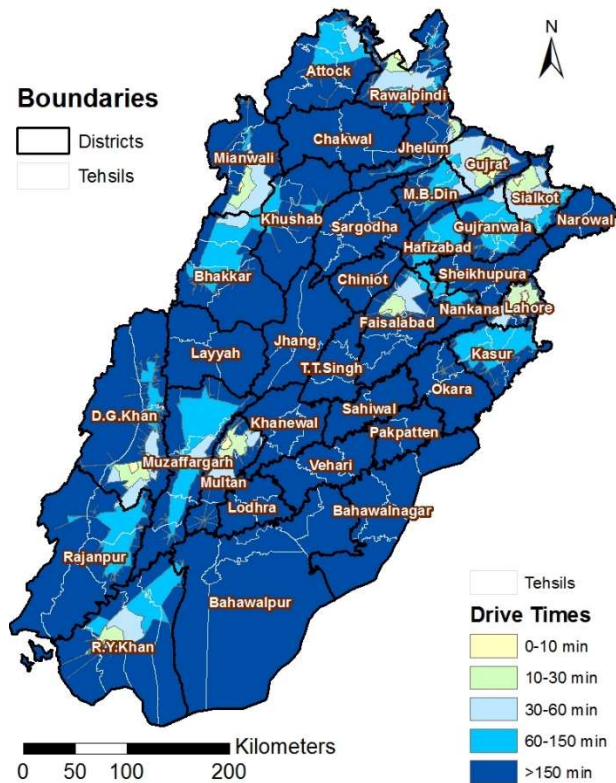


Figure 11: Accessibility to Airports

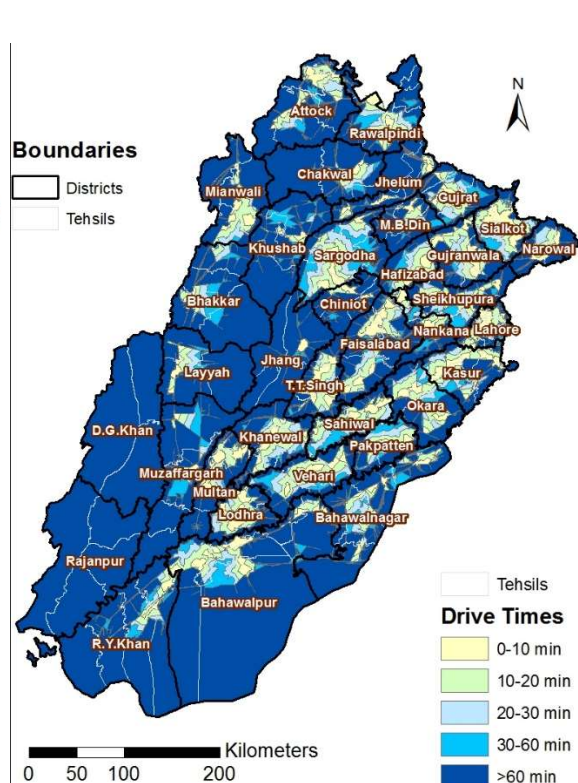


Figure 10: Accessibility to Railway Stations

Tehsil were then given scores for different modes of public transport, according to the set criteria and maximum score from either of them is taken to the tehsil's score for access to the public transport. The maximum score a tehsil can achieve in these criteria is 3.

### 3.2.7 Proximity to Service Centre Score

For the calculation of accessibility index score; two different criterion are considered by determining the proximity of tehsil centroids from service centers. These service centers include:

1. District centroids are considered as service centers for the criterion 1 and scoring is calculated on the basis of the proximity of tehsil centroids from districts centroids.
2. Actual service centers (point of interests) with in each district are considered as service centers for the criterion 2 and scoring is calculated on the basis of the proximity of tehsil centroids from these point of interests.

#### 3.2.7.1 Criteria 1

Every tehsil was also scored for its distance to the nearest district based on the four categories defined earlier on the basis of population of districts as shown in Table 4.

Population	Level	Time from Tehsil to the defined levels				
		Under 10 min	10 to 20 min	20 to 30 min	30 to 60 min	Above 60 mis
Less than 1.5 M	1	4	3	2	1	0
1.5M – 2.5M	2	5	4	3	2	0
2.5M – 4.5M	3	6	5	4	3	0
Above 4.5M	4	7	6	5	4	0

**Table 4: Summary of Scoring used for Proximity to Service Centers (District Centers)**

Now tehsil is scored for all the levels means a tehsil will get four scores for four levels of and the maximum of these four scores will be given to that tehsil. In this way, a tehsil can get maximum score of 7 and minimum score of 0.

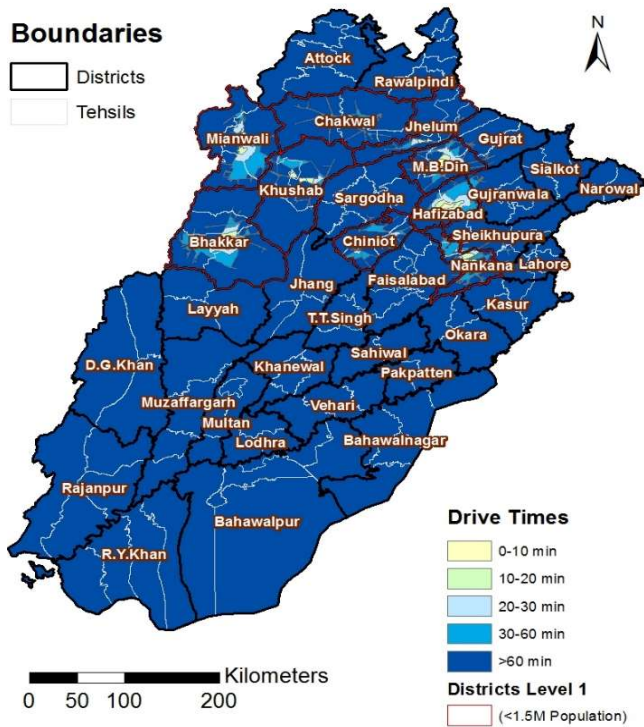
#### 3.2.7.2 Criteria 2

Every tehsil was also scored for its distance to the nearest POI of the district on the basis of population of districts as shown in Table 5.

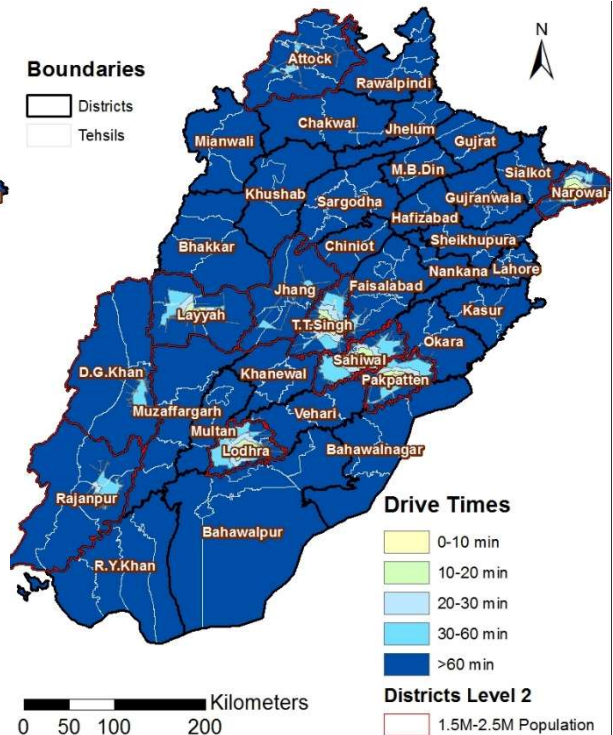
**Table 5: Summary of Scoring used for Proximity to Service Centers (POIs)**

	Drive Time from Tehsil Centre to POIs of Tehsil				
	<10 min	10-20 min	20-30 min	30-60 min	>60 min
POIs of Tehsil	0% of the POIs =0	0% of the POIs =0	0% of the POIs =0	0% of the POIs =0	0
	0.1-15% of POIs =1	0.1-20% of POIs =1	01.-25% of POIs =1	0.1-30% of POIs =1	
	15.1-30% of POIs =2	20.1-40% of POIs =2	25.1-50% of POIs =2	30.1-60% of POIs =2	
	30.1-45% of POIs =3	40.1-60% of POIs =3	50.1-75% of POIs =3	60.1-90% of POIs =3	
	45.1-60% of POIs =4	60.1-80% of POIs =4	75.1-90% of POIs =4	>90.1% of POIs =4	
	60.1-75% of POIs =5	80.1-90% of POIs =5	>90.1% of POIs =5		
	75.1-90% of POIs =6				
	>90.1% of POIs =7				

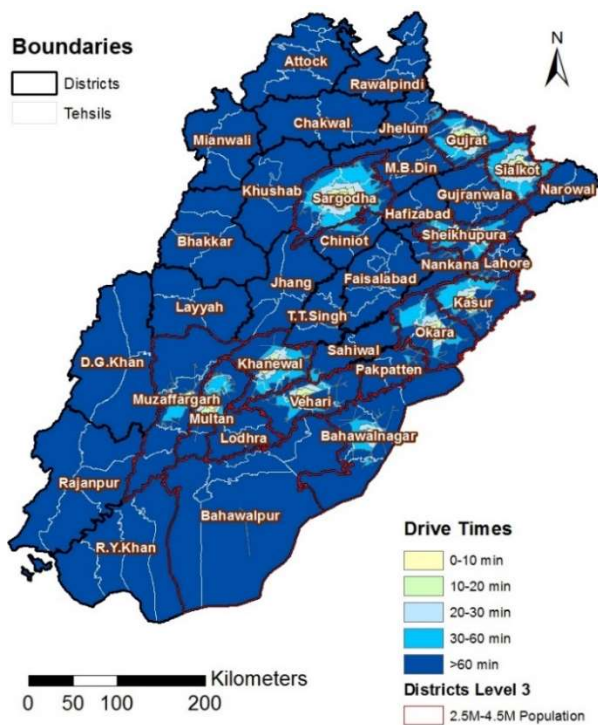
Now tehsil is scored according to the percentage of POIs with in the drive times from same tehsil centres and the maximum of these four scores will be given to that tehsil. In this way, a tehsil can get maximum score of 7 and minimum score of 0. Map 7,8,9,10 below are showing the different categories districts and their time distances from all tehsils in Punjab thus highlighting and giving us a clear picture of deprived areas.



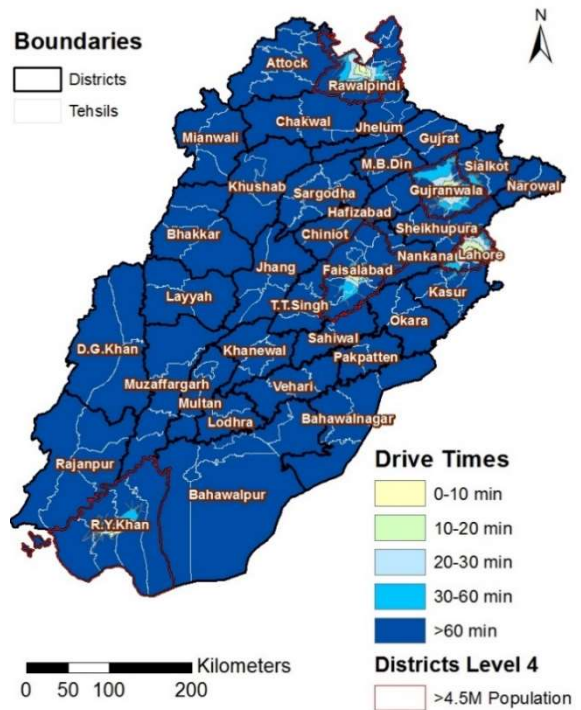
**Figure 13: Drive Time to the Districts of Population <1.5M**



**Figure 12: Drive Time to the Districts of Population 1.5-2.5M**



**Figure 15: Drive Time to the Districts of Population 2.5-4.5M**



**Figure 14: Drive Time to the Districts of Population >4.5M**

## 4 ACCESSIBILITY INDEX

Finally, the accessibility index is calculated by simply combining the two scores that is score for access to public transport and score for proximity to service centres (District Centres/ POIs). In combining the two scores 30% weightage i.e. accessibility index score of 3 is given to the access to public transport while 70% weightage i.e. accessibility index score of 7 is given to the proximity to the either large population districts in terms of population categories or POIs of the Tehsil. This is justified in terms that if someone lives near to the bus or railway station or airport but still the distance from service centres has considerable impact on travel time and consequently on expenses. Combining the two scores via a result in an overall Accessibility Index score ranging from zero (most inaccessible) to 10 (most accessible). For further clarity o picture three different scenarios were built for the purpose as described below

- Scenario 1 – Considering Bus stops only for the analysis of access to public transport.
- Scenario 2 – Considering Bus stops, Bus terminals and Railway stations for the analysis of access to public transport.
- Scenario 3 - Considering Bus stops, Bus terminals, Railway stations and Airports for the analysis of access to public transport.

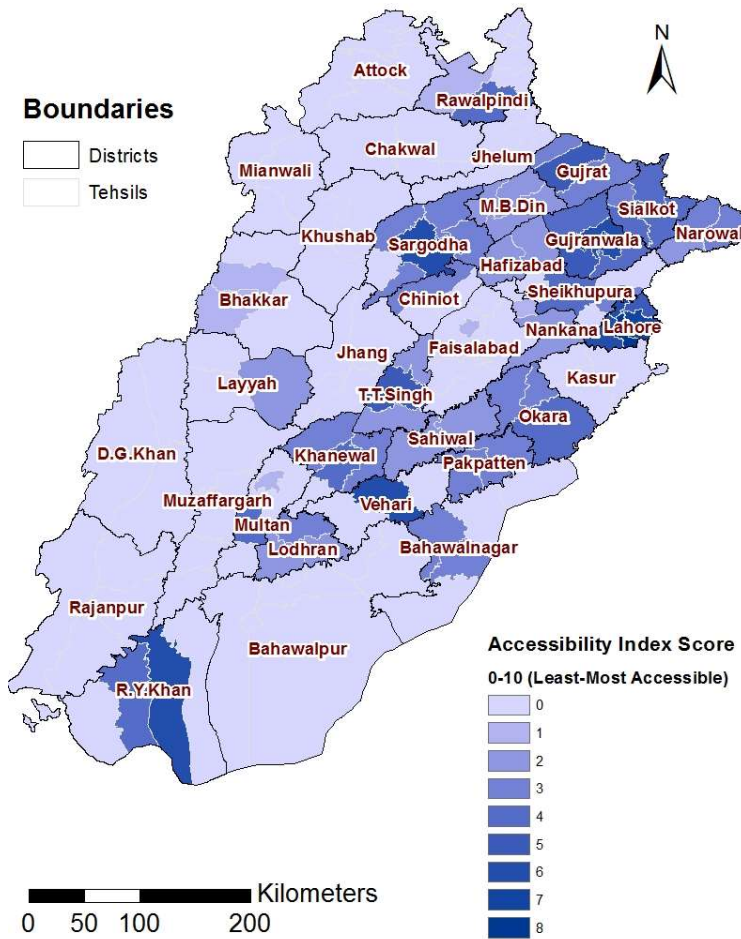
### 4.1.1 Criteria 1

#### 4.1.1.1 Scenario 1

In first scenario, for the first part of scoring for accessibility index calculation, only bus stops were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 5.

**Table 6: Accessibility Index Score of Punjab Tehsils-Scenario 1**

<b>Accessibility Index Score</b>	<b>No of Tehsil</b>
0	76
1	6
2	14
3	20
4	11
5	4
6	7
7	1
8	1
<b>Total</b>	<b>140</b>

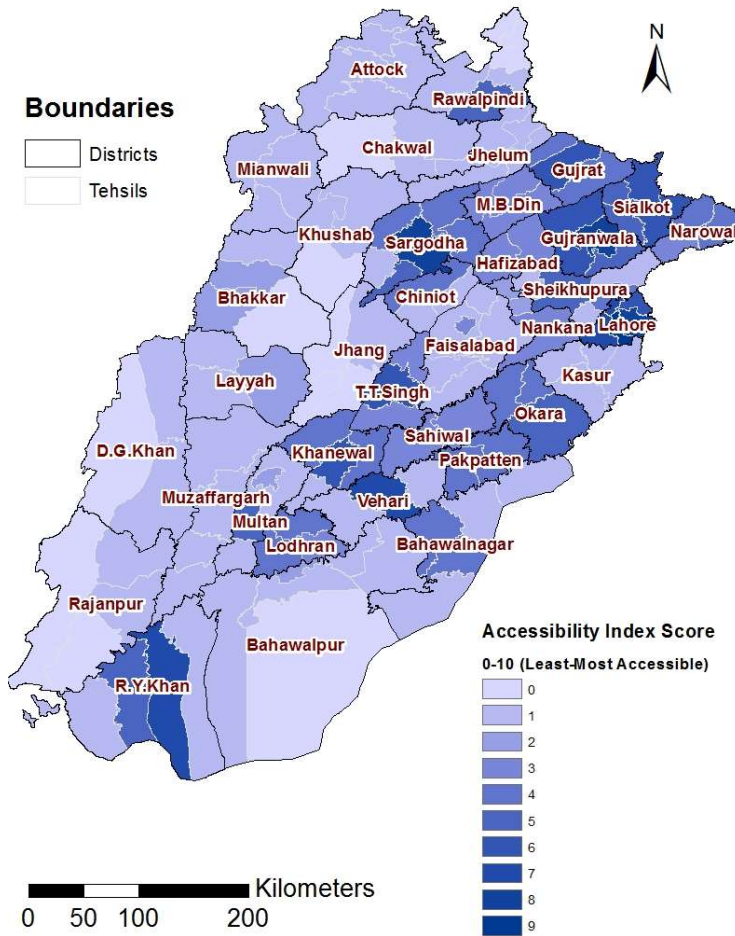


**Figure 16: Accessibility Index for Punjab (Bus Stops Only)**

In second scenario, for the first part of scoring for accessibility index calculation, bus stops, bus terminals and railway stations were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 6.

**Table 7: Accessibility Index Score of Punjab Tehsils-Scenario 2**

Accessibility Index Score	No of Tehsils
0	21
1	58
2	5
3	12
4	21
5	11
6	5
7	6
8	1
<b>Total</b>	<b>140</b>



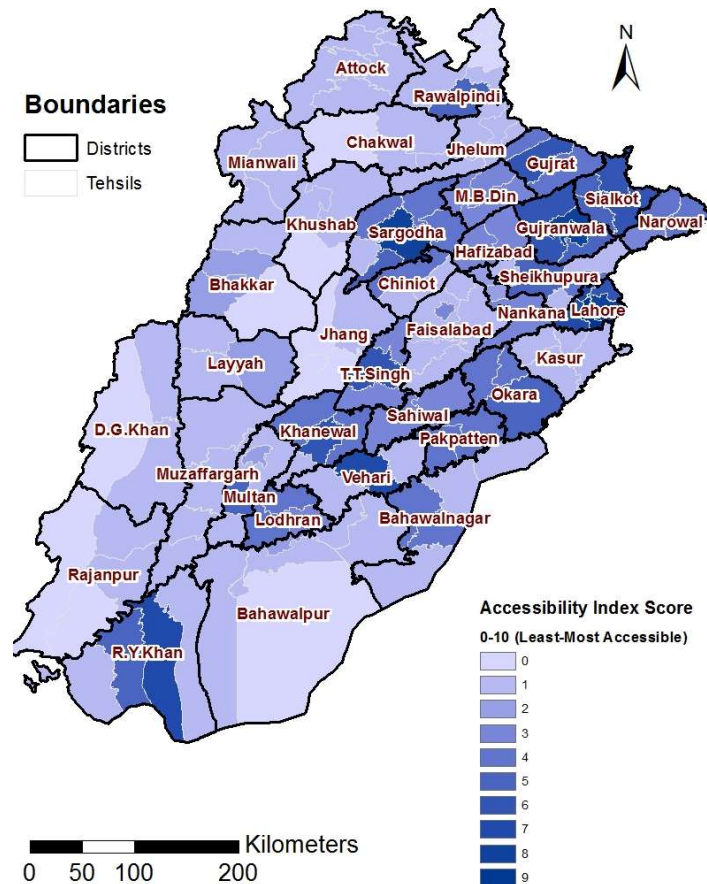
**Figure 17: Accessibility Index for Punjab  
(Bus Stops, Bus Terminals Railway Stations Only)**

### 4.1.3 Scenario 3

In third scenario, for the first part of scoring for accessibility index calculation, bus stops, bus terminals, railway stations and airports were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 7.

Accessibility Index Score	No of Tehsils
0	18
1	61
2	5
3	12
4	20
5	12
6	5
7	6
8	1
9	1
10	0
<b>Total</b>	<b>140</b>

**Table 8: Accessibility Index Score of Punjab Tehsils-Scenario 3**



**Figure 18: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations & Airports)**

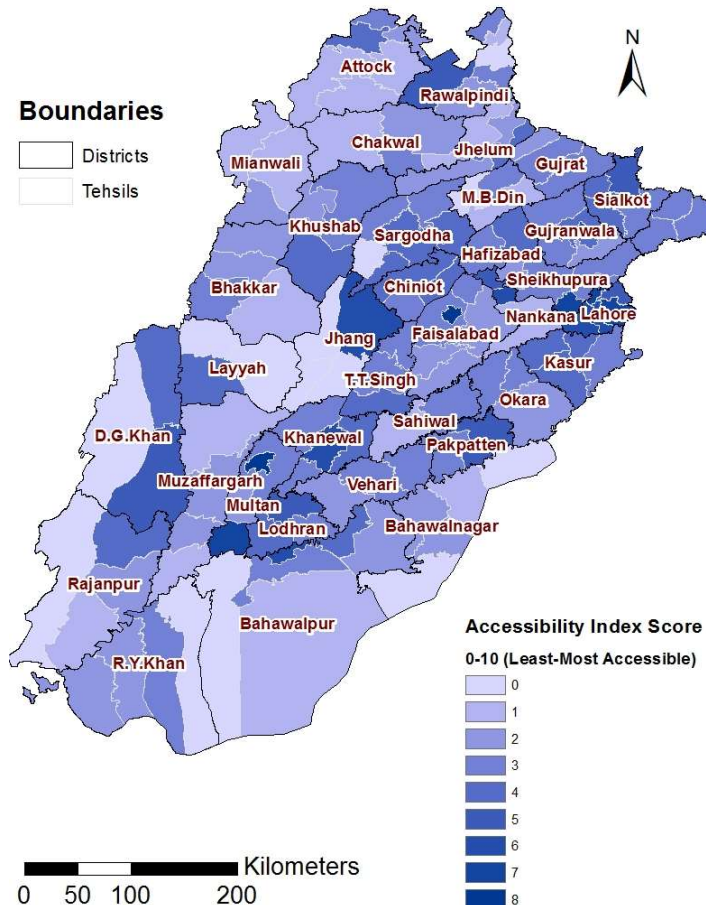
#### 4.1.4 Criteria 2

##### 4.1.4.1 Scenario 1

In first scenario, for the first part of scoring for accessibility index calculation, only bus stops were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 5.

**Table 9: Accessibility Index Score of Punjab Tehsils-Scenario 1**

Accessibility Index Score	No of Tehsil
0	14
1	18
2	27
3	39
4	22
5	7
6	7
7	4
8	2
<b>Total</b>	<b>140</b>



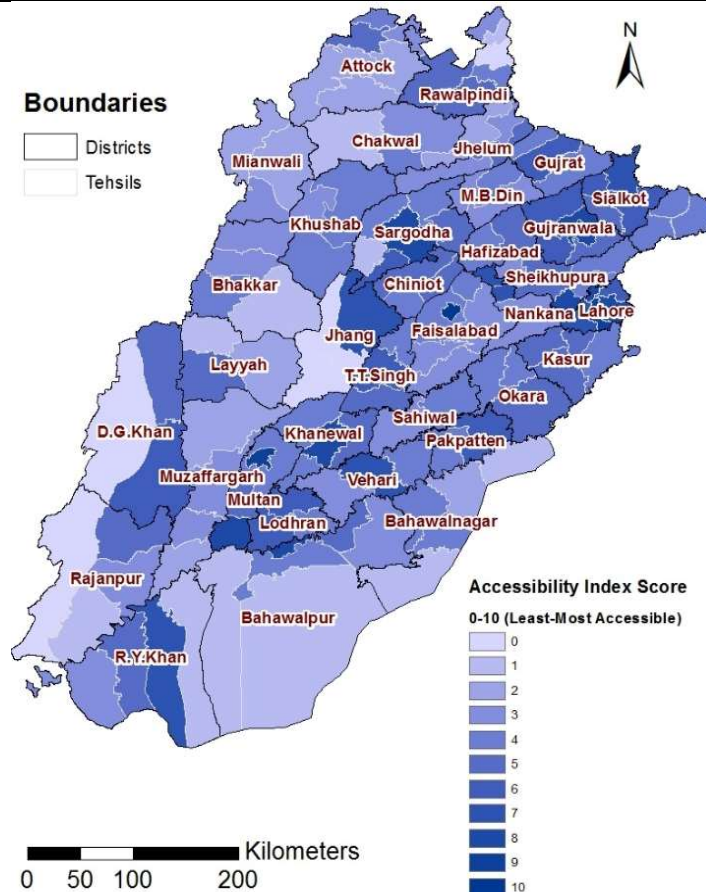
**Figure 19: Accessibility Index for Punjab (Bus Stops Only)**

#### 4.1.5 Scenario 2

In second scenario, for the first part of scoring for accessibility index calculation, bus stops, bus terminals and railway stations were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 6.

**Table 10: Accessibility Index Score of Punjab Tehsils-Scenario 2**

Accessibility Index Score	No of Tehsils
0	6
1	11
2	11
3	24
4	34
5	23
6	12
7	7
8	8
9	3
10	1
<b>Total</b>	<b>140</b>



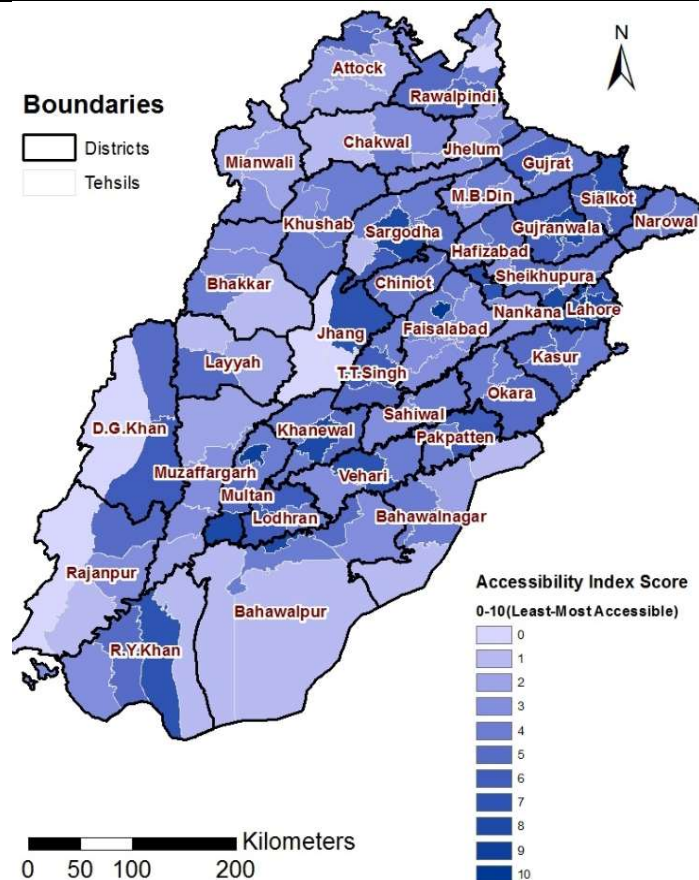
**Figure 20: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations Only)**

### 4.1.6 Scenario 3

In third scenario, for the first part of scoring for accessibility index calculation, bus stops, bus terminals, railway stations and airports were considered together with proximity to service centres. Based on this assumption following were the results obtained after analysis mentioned in Table 7.

**Table 11: Accessibility Index Score of Punjab Tehsils-Scenario 3**

Accessibility Index Score	No of Tehsils
0	6
1	11
2	11
3	24
4	34
5	23
6	12
7	7
8	8
9	3
10	1
<b>Total</b>	<b>140</b>



**Figure 21: Accessibility Index for Punjab (Bus Stops, Bus Terminals Railway Stations & Airports)**

As can be seen from the Table, only 18 tehsils of the province have an accessibility score of zero for criteria 1 and only 6 tehsils of the province have an accessibility score of zero. This means that accessibility index score has been improved after incorporating the POIs of the districts.

## **5 CONCLUSIONS AND RECOMMENDATIONS**

In the development of methodology, many options are evaluated and considered before the final approach is taken. Some indicators that should be taken to yield the better result; are not considered due to time and resource constraints as follow:

- Car ownership levels
- Bus and Train Frequencies
- Vehicle Availability
- Allied Systems

After the complete analysis of public transport of Punjab and evaluation of results following re the conclusions.

- The base map may be overlaid with many complimentary datasets without the concerns about collinearity.
- Although the inputs are limited due to time and resource constraints, the results are quite reasonable and consistent with perceived and anticipated patterns.
- This index provides a guideline for future transportation planning and infrastructure evaluation in Punjab. Those tehsils which have poor score should be examined with respect to provision of public transport accessibility and an integrated approach pertaining to route, modes and type of service may be employed for the local needs of the resident population.