Accessibility Analysis of Roads Network in Al-Qassim Region

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Abstract: There is wide debate on the role of the transport roads network and changes in accessibility on regional economic development. However, any improvements in accessibility will lead to economic development. The main goal of this paper is to analyze the accessibility of the roads network in the Al-Qassim region. Three types of accessibility measures are used in analyzing the accessibility of roads: the Shimbel Index, the number of direct connections to other centers which is obtained directly from the connectivity matrix, and the number of nodes between every two nodes. In accordance with the results of the study, the accessibility of roads able to contribute to regional economic development in the Al-Qassim region, thus reducing distances and bringing the peripheral regions closer to the central ones.

Keywords: *Accessibility, Roads Network, and Al-Qassim Region.*

Introduction

There is wide debate on the role of transport roads network and changes in accessibility on regional economic development. However, any improvements in accessibility will lead to economic development. Transport is usually defined as the means by which people and commodities move from one place to another, by a number of physical modes including roads, water, railways, airlines and pipelines. The focus of this paper is on roads because this is the only mode of transportation in the study area (Al-Qassim region).

Transportation is considered a subject matter of Economic Geography which includes Agricultural and Industrial Geography. Goodall (1987: 142) stated that "the development of Economic Geography over the past three decades has witnessed the substitution of analysis for description, leading to an identification of the factors and an understanding of the process affecting the spatial differentiation of economic activities over the earth's surface". Transport has become an important subject matter for geographers for two main reasons. Firstly, transport is a significant human activity with a strong spatial component. Secondly, it is an important factor influencing the spatial variation of many other social and economic activities (White and Senior, 1983). Thatcher (1958) also stated the relation between transport and Geography was important not only because of its connection with Economic Geography, but also because transport affects almost all the branches of Geography such as: human, regional, urban, political and even the physical.

Spatial accessibility has become a prerequisite to the integration of the urban center and its circumference (Cao et al., 2006). The spatial evolution of a metropolitan area and the development of its transport network are interdependent processes (Li and Lu, 2005). A well-developed transport network has become the basic condition and essential prerequisite to the systematic operation of the whole metropolitan area, the accessibility of which determines whether or not the material flow, the energy flow and the information flow are smooth between the urban center and its circumference. Through accessibility analysis, the interactive degree between the urban center and its circumference can be well reflected (Hansen,1959). So are the exchange opportunities and potentiality in social, economic, cultural and technology sections between the two parts. It is the focus of current research in the field to reveal the geo-spatial

characteristics of the metropolitan area, and analyze and evaluate the spatial structure of the same by studying its transport network and the spatial accessibility between the urban center and its circumference (Hodge, 1997).

In this paper, reference is made to some gradual changes in the economic characteristics of the Al-Qassim region, which are largely associated with the evaluation of the transport roads network. According to Rosemary and Bromley (1982: 6), "in human Geography, and in such other Social Sciences as Economics, Politics, Sociology and Anthropology, the term 'development' is used to refer to any process of gradual, long-term changes in the conditions affecting human life." Based on Mieczkowski (1978: 1) "the transport system may be likened to the blood circulation system in a living organism. Without it the organism dies". Transport is considered an essential feature of all modern economies. In general terms, as an economy grows and develops, it becomes more dependent upon its transport sector (Bamford and Robinson, 1978). Thus, it seems indisputable that the transport sector is a telling indicator of the region's economic development.

Transport development in the Kingdom of Saudi Arabia is a prerequisite for economic development. Over the last twenty years, road transport has helped in creating some degree of agricultural specialization and in finding new markets. The provision of transport has led different regions in the country to develop their own products or adopt new ones, for example growing wheat and vegetables in Al-Qassim. Before using new technologies such as improved seeds, fertilizers and irrigation, every region had to cultivate and consume its own products; in other words they were self-sufficient with limited trade beyond each region.

The new transport network has enabled the movement of agricultural provision to remote areas and has also helped to transport crops to markets. In many cases when a road was built to an area, there was a steady growth in production; for example, when the road network was extended in the Al-Qassim region, the production estimation of all cereal in the same region increased from about 496.512 tons in 1995 to 692.728 tons in 1999 (MOP, 2000). This was due to the fact that importing fertilizers and new seeds into the area was now easy and economical. But before the development of roads network during the 1960s, such developments were impossible because of the dependence upon camels for transportation. Subsequently, the region has become

more involved in internal trade and in exporting to the Gulf countries, being connected by the new road network, after the first plan development in the beginning of the 1970s. The development of transport thus contributed to the development of agriculture, which has become a major source of income for the population of the area.

The main goal of this paper is to analyze the accessibility of the roads network in Al-Qassim region. Three types of accessibility measures are used in analyzing the accessibility of roads: the Shimbel Index, the number of direct connections to other centers which is obtained directly from the connectivity matrix, and the number of nodes between every two nodes.

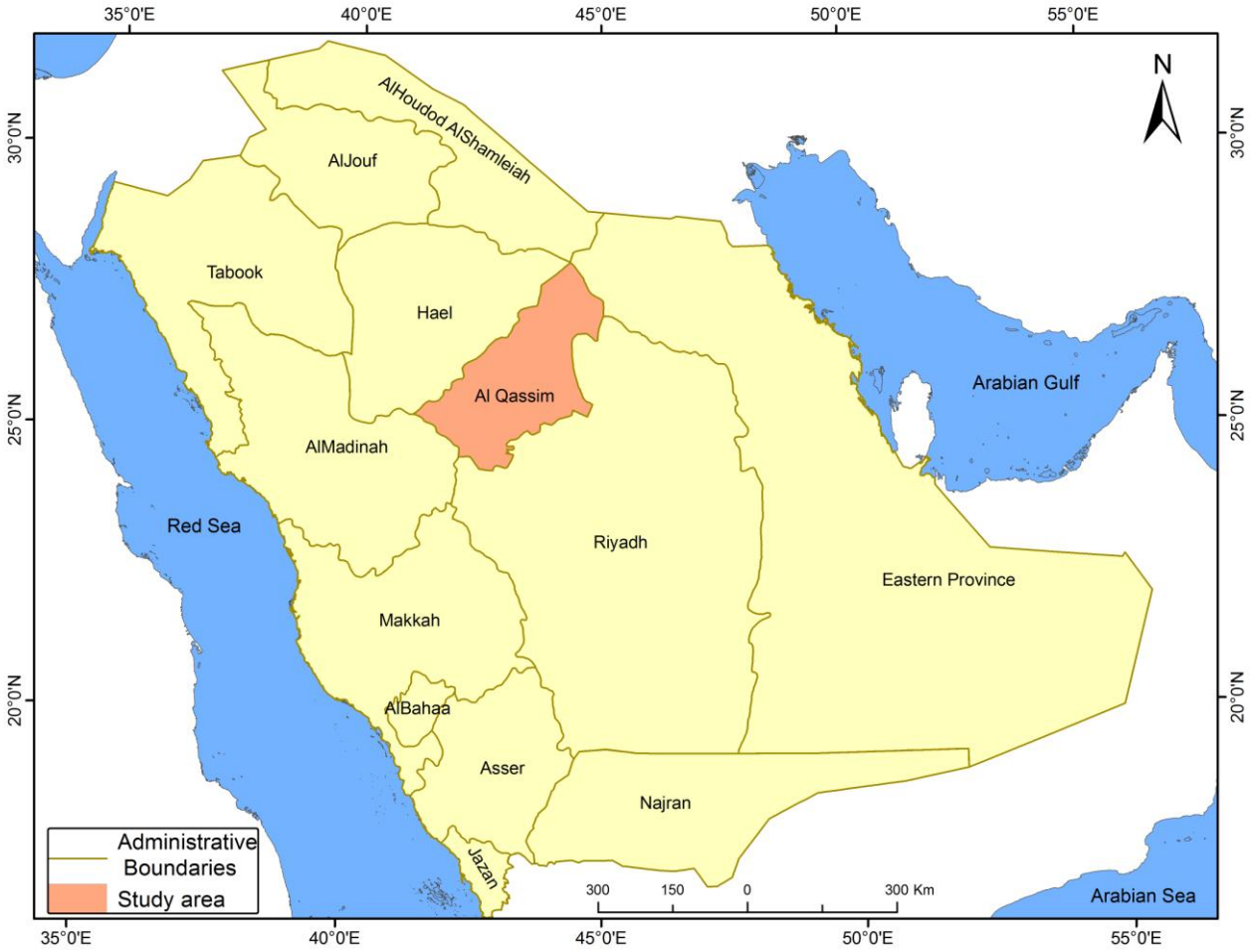
The Study Area

Al-Qassim Region, which is the target of this research, is located in the heart of the Kingdom of Saudi Arabia (see Map 1). It lies approximately 330 kilometres northwest of the capital, Riyadh, and occupies an area of about 70,000 square kilometres or nearly 3.7% of the total area of Saudi Arabia. It is geographically located between E40° 00', E45° 00' longitude and N23° 30', N28° 00' latitude. Furthermore, the Al-Qassim Region consists of ten sub-provinces and 155 local centres. According to the last estimate (2010), Al-Qassim's population totalled nearly 1,234,531, which gives a population density of 17.4 people per square kilometre, while KSA's density is 13 people per square kilometre. Moreover, the Al-Qassim Region comes in seventh out of the thirteen provinces in terms of population and the main economic activity is agricultural.

Compared to other provinces in the Kingdom of Saudi Arabia, the Al-Qassim Region has a good road network of approximately 6465 kilometres linking its cities, towns and villages. The agricultural nature of the region requires an adequate road system to enable farmers to transport their products to market. Furthermore, the highway system in the Al-Qassim Region was greatly expanded during the 1980s due to its geographical position in the Kingdom, as well as its importance as a prime agricultural area, and the region was given special attention in respect of road construction. As a result of its location, it became the hub of the road network with roads from the east linking with those from the west of Saudi Arabia. For example,

the highway linking Dammam in the eastern part of Saudi Arabia with Yanbuh in the western part passes Riyadh, Al-Qassim and Madinah. Also as a result of its geographical location, the road network of the Al-Qassim Region plays an important role in the movement of pilgrims, especially those from Gulf countries.

Map 1: The Location of Al-Qassim Region



Source: Atlas of The Kingdom of Saudi Arabia 1999

Methodology

Due to a dearth, though not absence, of data on the transport system in the Kingdom of Saudi Arabia, more than one method was used to gather appropriate material. This study concerns itself mainly with the description and analysis of data obtained from published statistics and updated surveys, and from fieldwork carried out by the researcher in March and April 2013. A variety of materials and reading that pertain to

aspects of transportation and which relate to the topic of the research have also been covered. Data was collected from the following sources:

1- Written materials relating to the research subject or the study area.

2- Books and articles relating to the study of transportation in the Kingdom of Saudi Arabia and in the Gulf countries. These sources offer glimpses into the history of transport modes in the region's cities.

3- Official statistical abstracts and reports published by government bodies. These secondary sources include documents from the Municipalities of Buraydah, Unaizah and Arras. Also, some ministries provide information and reports related to the research task and they are as follows:

- Ministry of Communications (MOC).
- Ministry of Planning (MOP).
- Ministry of Information (MOI)
- Ministry of Finance and National Economy.
- Ministry of Agriculture.
- Central Department of Statistics and Information.

The above official bodies were unable to provide sufficient information to complete this research. For this reason, and also because of the confidentiality of some of the data, direct field investigation was necessary to achieve the main objectives of the research.

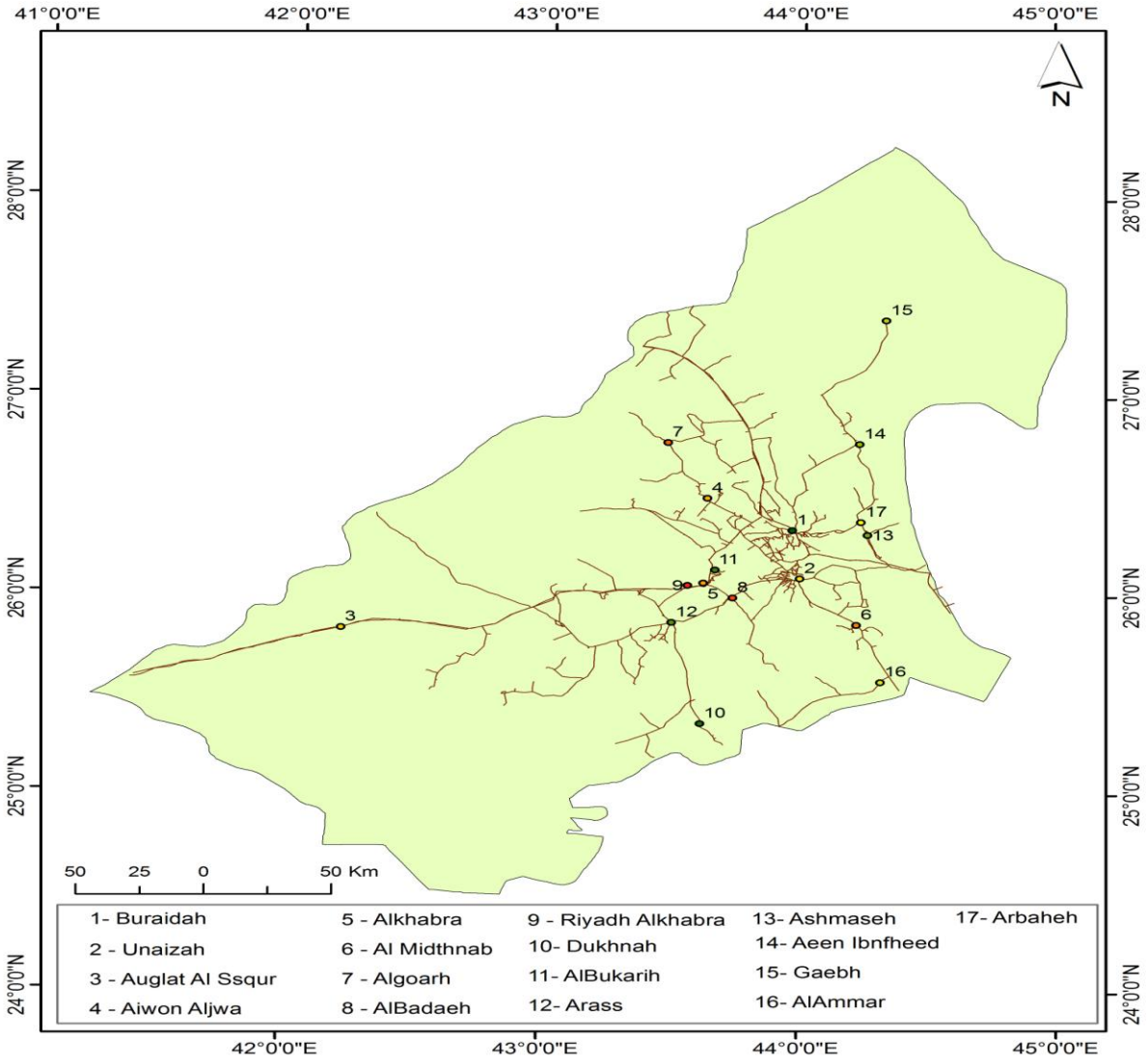
4- Fieldwork was carried out in the Al-Qassim Region during March and April 2013 to investigate the improvement in some parts of the road transport network. Additionally, many government agencies were contacted and information collected. Many booklets and reports were made available to me and specific questions were answered.

The History of Roads Network in Al-Qassim Region

The road network is made up of single roads which link together two or more points or centres of movement. It may therefore be regarded as a set of interconnected roadways along which movement takes place. Different modes of transportation form

prominent landscape features and indeed roads, railway tracks, waterways and electricity structures form imposing features on the landscape and in well-populated, industrial and urban areas there is usually a dense pattern of transportation lines (Bamford and Robinson, 1978).

Map2: The Roads Network of Al-Qassim Region 1989



Source: MOC 1988

As mentioned before, Al-Qassim Region is considered to be one of the main regions of the Central Province and its proximity to the Kingdom's capital of Riyadh has given it advantages with respect to various aspects of development. In this section

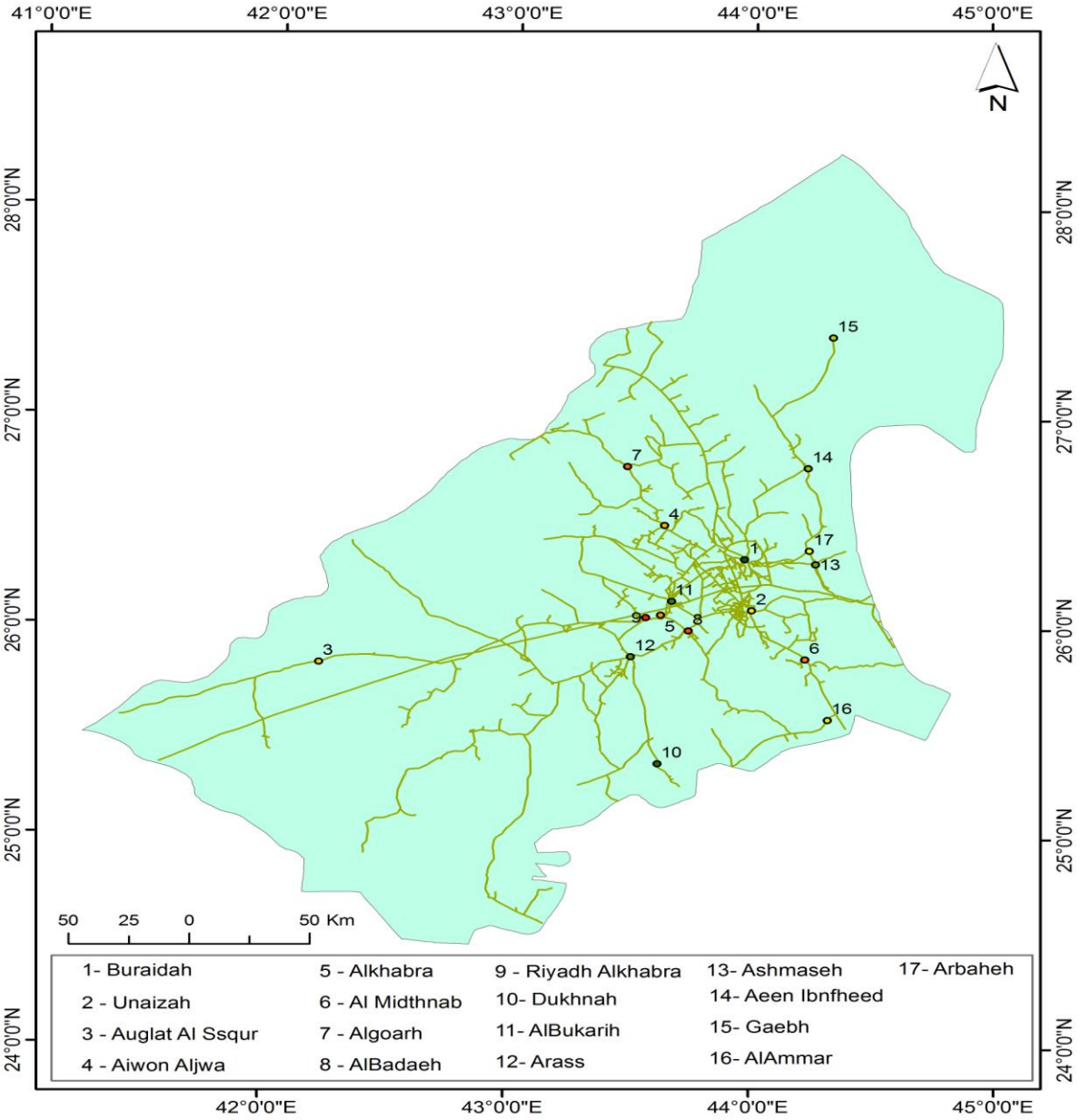
maps are presented illustrating the different stages of development of the Al-Qassim road network, from the 1980s till the present time (see Map 2). In conjunction with the Kingdom's five-year plans, the MOC prepared its own comprehensive plan known as the Five-Year Road Programme. This programme, as earlier stated, was concerned with connecting the maximum number of towns and villages and also with the construction of short distance roads.

The highway system in the Al-Qassim Region was significantly expanded during the 1980s due to its geographical position in the Kingdom as well as its importance as a prime agricultural area. The region was therefore given special attention in respect to road construction. The agricultural nature of the region also required an adequate road system to enable the farmers to transport their agricultural products to market. The government of Saudi Arabia, realizing this, has invested huge sums of money to develop a major network of highways (Abalkhail, 1992).

The first modern road in the Al-Qassim Region was built in 1964 and completed in 1966, with a length of 152 km and linking Buraidah, Unaizah, Muthnab and Sajer (MOC, 1988). Before the commencement of the first development plan in 1970, the total length of the road network of the region did not exceed 600 km (MOI, 1992). Also, during the first and second development plans from 1970 to 1980, the road construction programme in the region established only secondary and feeder roads, with the total length of the roads network at the end of the second development plan being 1306 km (MOC, 1992).

The revolution in the road network in this region took place in the 1980s, during the third and fourth plans, with the construction of expressways such as Riyadh to Al-Qassim. The growth in the total length of other roads - primary, secondary, feeder and agricultural - has been phenomenal (see Map 3). As a result of the boom in the economy during the eighties when the Kingdom entered a phase of rapid development, the total length of roads in the region was 2624 km, which is double the length in the seventies (MOC, 1992). Abalkhail (1992) stated that special attention was given during this stage to the construction of agricultural roads due to the region's essentially agricultural nature and a total of 509 km of agricultural roads were built during the period from 1980 to 1988.

Map 3: The Roads Network of Al-Qassim Region 2003

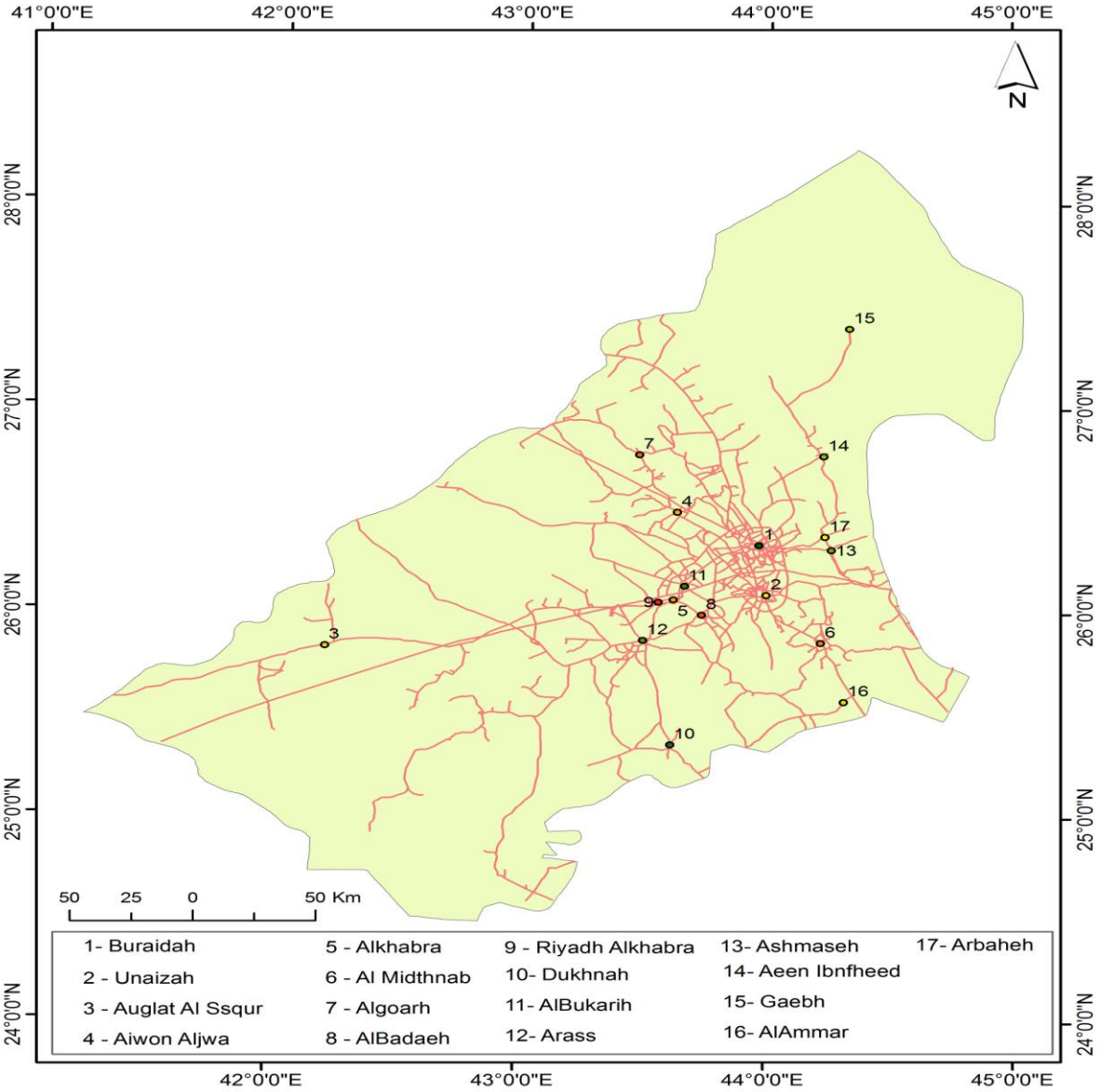


Source: MOC 2003

During the fifth development plan period, from 1990 to date, the Ministry of Communications has completed the linkage of the Al-Qassim Region to the rest of the Kingdom and beyond, making it accessible through a series of high-quality highways. Ghanim (1994) states that during this stage the MOC has covered operations, maintenance projects, and the expansion of some roads, such as the Buraidah-Unizah

road, the Buraidah-Bukareh road, and the Bukareh-Khabra road. Also, expansion of the network in this period linked the farthest point in the southwest of this region (Dhareh) with other towns by means of the Dekhnh-Arass link. There were also several modern road circuits constructed in this region, such as Buraidah-Unizah-Badaeh-Bukareh and Buraidah again (see Map 4). The total length of roads in the region is 6465 km (MOT, 2013).

Map 4: The Roads Network of Al-Qassim Region 2013



Source: MOT 2013

The linking of the Al-Qassim Region to other regions of the Kingdom by the major primary roads and the inter-region roads is described below:

Al-Qassim-Riyadh Highway

In the mid 1980s, the region was linked to the city of Riyadh by an excellent 317 km motorway. Overall, this highway system was a monument to modern road-building techniques with impressively engineered bridges through the arduous terrain of the Al-Qassim Region. It took four years to build and has forty-seven bridges. Moreover, this highway facilitated civilian travel as well as commerce throughout the region. This six-lane expressway links the productive agricultural region of Al-Qassim with Riyadh and the rest of the country and also links Riyadh and the east of Al-Qassim Region, considered to be the main point of entry to Al-Qassim from the east, in addition to passing through the Sedear Region and serving more than 60 towns and villages (MOC, 2003).

Al-Qassim-Madinah Highway

This road, linking with the Al-Qassim-Riyadh expressway, is very important due to the increasing volume of traffic and is considered one of the major attractions for bringing pilgrims, especially during the Hajj season. Moreover this highway also plays a significant role in transporting passengers and goods between the two regions. It is 440 km in length and consists of six lanes (three in each direction), with a 20-metre wide median island. Construction costs were SR 5.350.0 million (SAMA, 2002).

Al-Qassim-Hail Highway

This road runs from Al-Qassim towards Hail, passing through Sharri for a distance of 284 km. Its importance derives from the fact that the Al-Qassim and Hail regions are considered the main agricultural areas of the Kingdom, transporting products to regions throughout the Kingdom (Alruwithy, 2000).

King Abdulaziz Road

This road links Buraidah and Unaizah, which are both large cities in the Al-Qassim Region, and extends to Muthnab (about 60 km) (MOC, 1992).

The considerable achievements described above are the result of various studies and programmes undertaken in co-ordination with a number of ministries and government agencies with regard to the perceived need for roads in the region. The overall objective was to connect all settlements in the Kingdom with the principal urban areas, thereby opening up channels for the government to provide necessary services for the entire population. Putting the Kingdom's road network in place has been one of the fundamental aims of the government in order to meet the basic requirements of national development. Without a functional and modern road network, national development on the scale achieved would not have been possible, as the existence of an adequate network of roads is a basic necessity for the economic and social progress of any developing country.

Accessibility of Roads Network

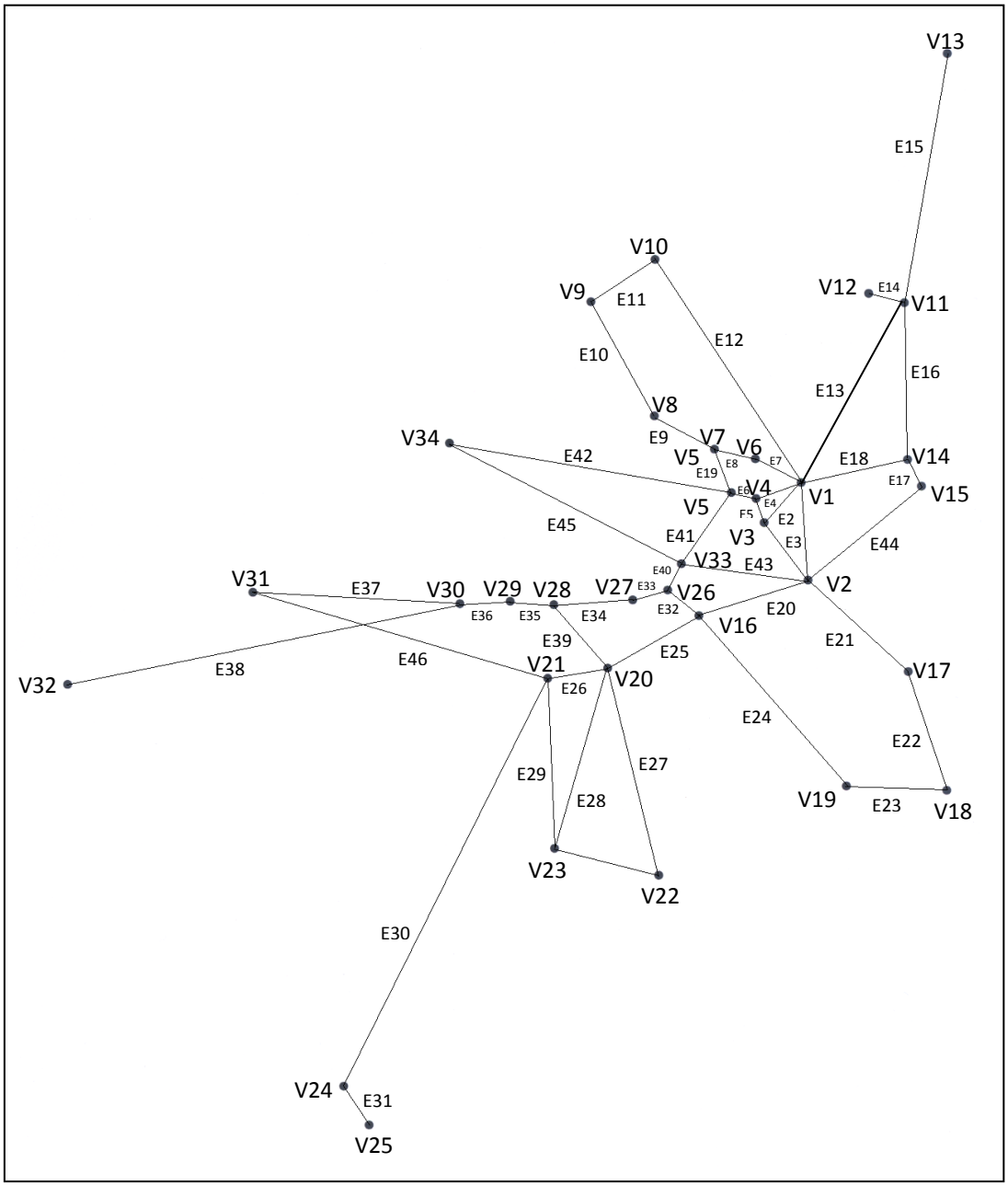
Accessibility is considered one of the most important attributes of a transportation network. Moreover, it is a key element in transport geography where the geographers are concerned with accessibility as a location of feature. "The accessibility of a node can be expressed in terms of either the links (routes) or the traffic flow by which it is connected with the rest of the network" (Hammond and McCullagh, 1978: 59). Bamford and Robinson stated (1978) that there are some important aspects which must be considered when the transport network is examined, such as the relationship of the linkages and flows between centers or functions of nodes and accessibility. Therefore, the main idea is to abstract the transport network into a geometric network or topological network and then evaluate the accessibility of it in three different ways:

(1) The number of direct connections to other centers which is obtained directly from the connectivity matrix. A summation of each row of the matrix equals the total number of direct linkages from one given node to another. The higher the value of an individual node, the greater is its accessibility to all other nodes.

(2) By the Shimbel Index, designed from the shortest-path matrix, which indicates the number of arcs needed to connect any node with all the other nodes in the network by the shortest path.

(3) The number of nodes between every two nodes, where the node which connects directly with other nodes without passing through any node is considered the best node (Cited in Al-Rakeiba, 1991).

Map 5: The Nodes and Edges of Al-Qassim Road Network



The road transport network in the Al-Qassim Region links all the main settlements. Therefore, the purpose of this section is to analyze the present distribution of the main network of asphalted roads, i.e. the inter-city and principal rural roads, but not feeder roads or intra-city roads. To understand the broad structure of the road network, it is useful to reduce the actual network to a topological network, which looks at a transport network in its simplest form. The topological map of the road network in the Al-Qassim Region consists of thirty-four nodes (see Table 1) connected with each other by forty-six edges. The nodes include most of the urban centres in the Al-Qassim Region with more than two thousand people, and they connect with other centres of the network by paved roads, both direct and indirect (see Map 5).

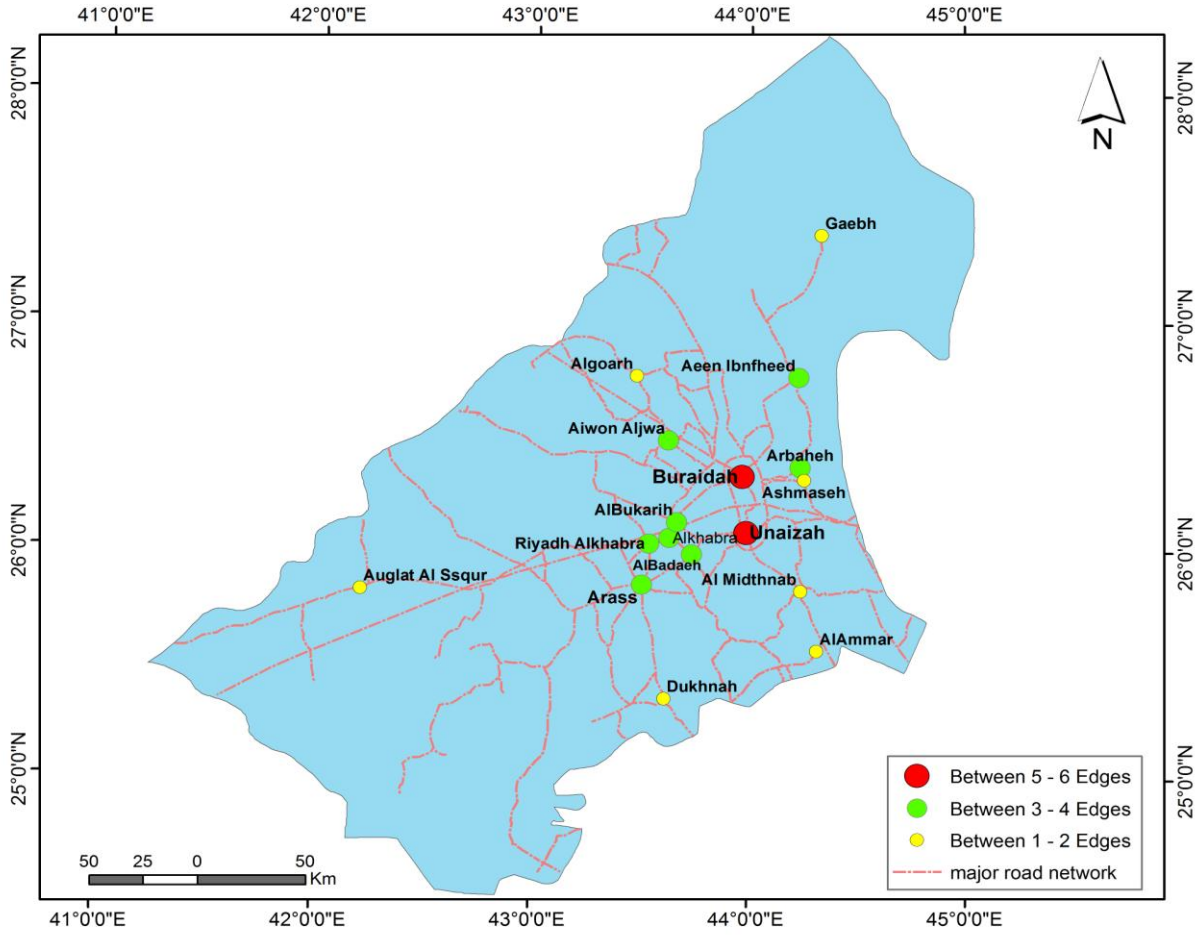
Table 1: The Nodes of the Topological Map

	Node	Number of node		Node	Number of node
1	Buraidah	V1	18	Al Ammar	V18
2	Unaizah	V2	19	Kharma	V19
3	Ghmas	V3	20	Arass	V20
4	Al Busser	V4	21	Qasser Ibn Hugael	V21
5	Mulaida	V5	22	Dukhnah	V22
6	Ashugah Sufla	V6	23	Adhalh	V23
7	Al Garha	V7	24	Smhoodeh	V24
8	Aiwon Aljwa	V8	25	Dhreh	V25
9	Algoarh	V9	26	Alkhabra	V26
10	Gussaiba	V10	27	Riyadh Alkhabra	V27
11	Aeen Ibnfheed	V11	28	Al Graen	V28
12	Alkhussabh	V12	29	Adlamih	V29
13	Gaebh	V13	30	Atheebih	V30
14	Arbaheh	V14	31	Al Foarh	V31
15	Ashmaseh	V15	32	Auglat Al Ssqur	V32
16	Al Badaeh	V16	33	Al Bukarih	V33
17	Al Methnb	V17	34	Al Foalig	V34

The degree of accessibility can be measured topologically in three different ways as follow:

First way: the number of direct connections to other centres; this is obtained directly from the connectivity matrix. The node with the biggest number of direct edges is considered the highest connected (see Index 1).

Map 6: The Accessibility by the Number of Direct Connections to other Centers

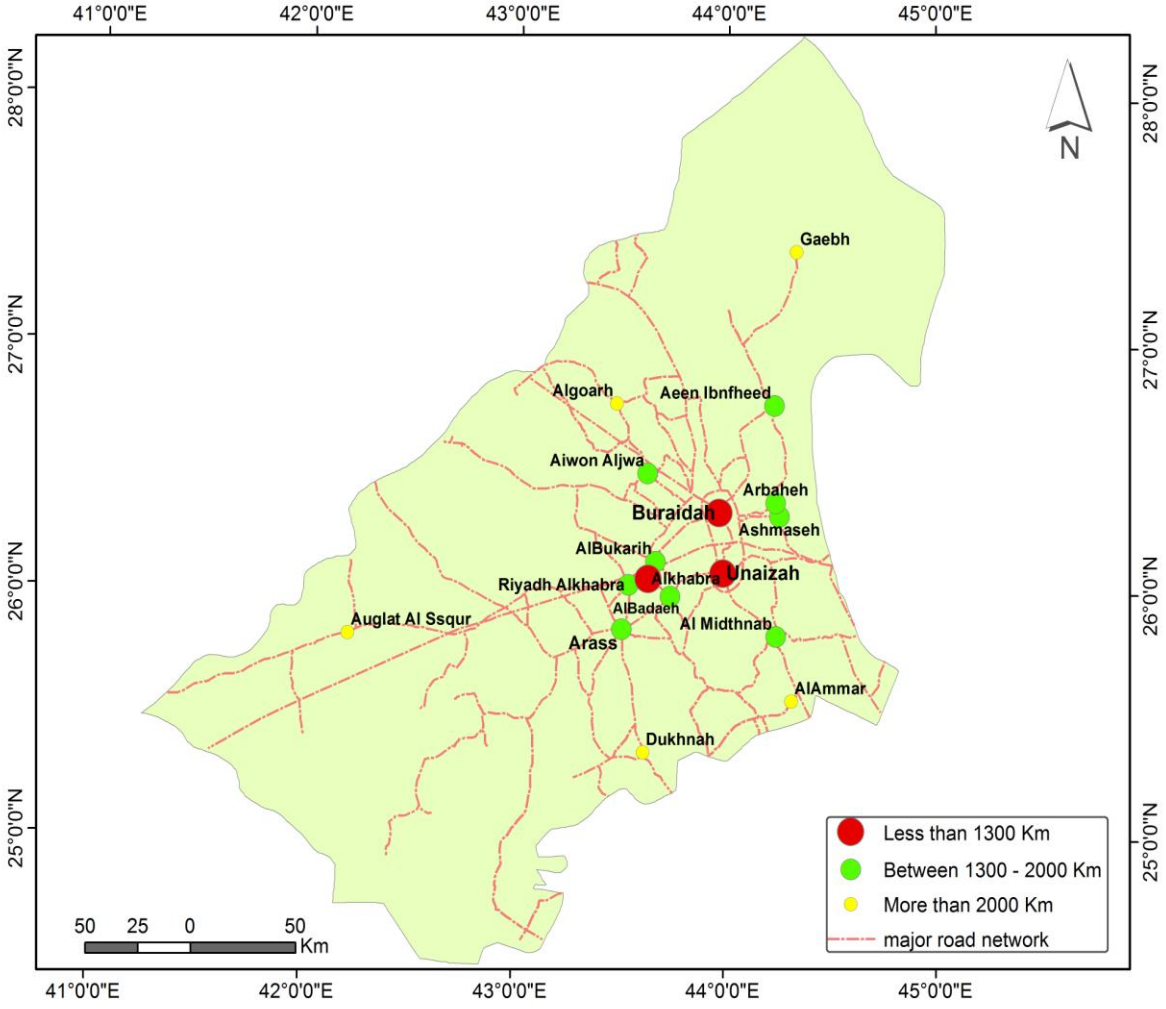


Unaizah comes in the first rank, where it connects by 6 direct edges with other nodes in the network. After that, Buraidah comes in the second rank with 5 direct edges (see Map 6). There are three nodes having 4 direct edges and they are: Aiwon Aljwa, Arass and Al Bukarih. In the fourth rank with 3 direct edges are: Aeen Ibn fheed, Arbaheh, Al Badaeh, Alkhabra, and Riyadh Alkhabra. In the fifth rank, there are three nodes with 2 direct edges, and they are: Ashmaseh, Al Methnb and Auglat Al Ssqur.

In the final rank, there are two nodes with only one direct edge, and they are Dukhnah and Algoarh.

Second way: the Shimbel Index, which is designed from the shortest-path matrix. This measures accessibility by the real distance between the nodes of network (see Index 2).

Map 7: The Accessibility by the Shimbel Index

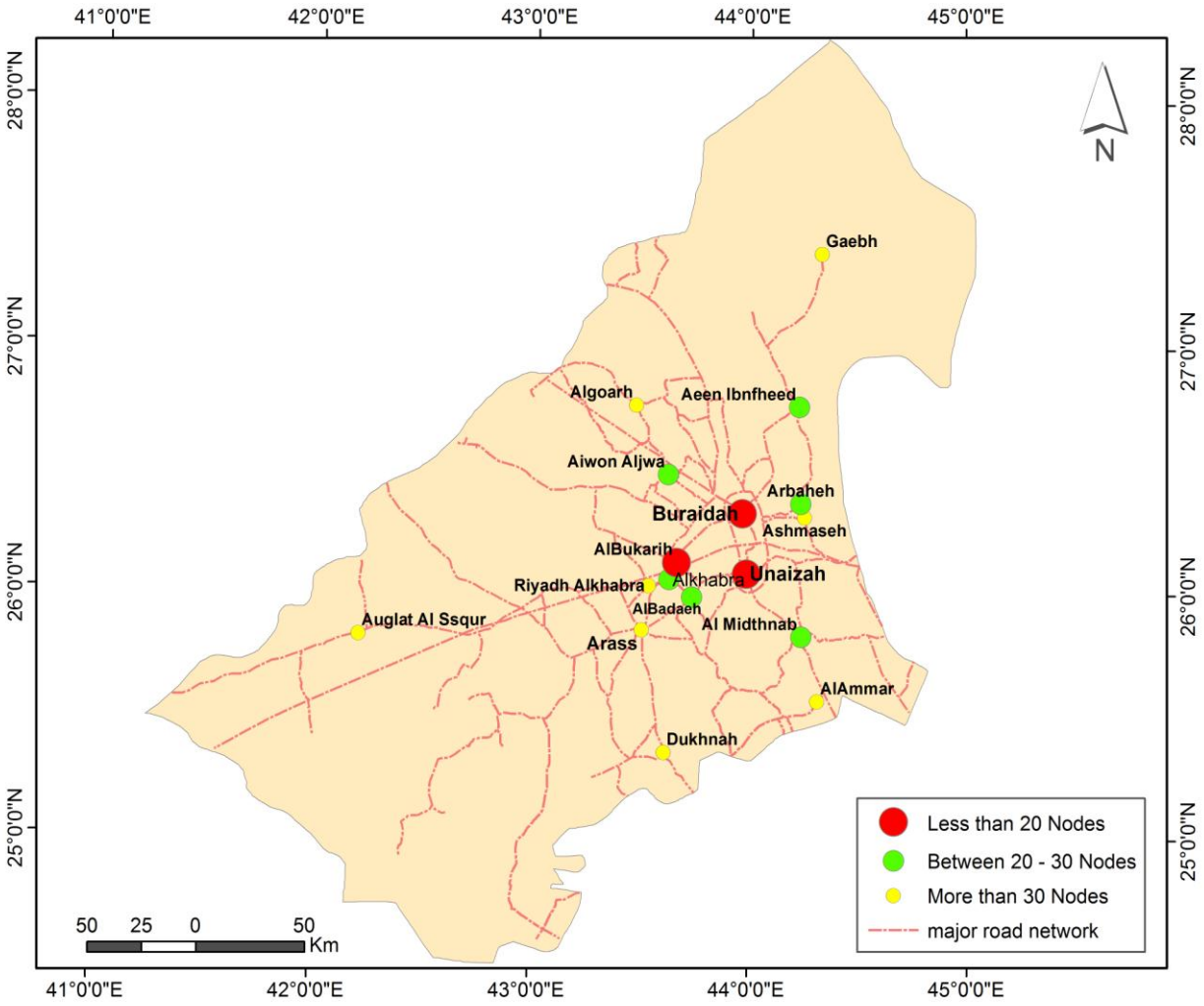


Unaizah again comes in the first rank in terms of accessibility to the rest of nodes by shortest distance, in that the total length of roads is 1253 km. Also, Buraidah comes in the second rank close to the value of Unaizah, where the total of the length of roads is 1260 km. Therefore they can be considered as central nodes in the road network of the Al-Qassim Region (see Map 7). After that, there are four nodes in the third rank and they are respectively: Alkhabra, Al Bukarih, Al Badaeh and Riyadh Alkhabra. In the

fourth rank there are six nodes with a total length of roads of more than 1500 km, and they are respectively: Arbaheh, Ashmaseh, Aiwon Aljwa, Al Methnb, Arass and Aeen Ibnfheed. The final rank consists of marginal nodes which lie at the entrances to the road network and their total length of roads is more than 2000 km and they are as followa: Algoarh, Al Ammar, Dukhnah and Auglat Al Ssqur.

Third way: the number of nodes between every two nodes i.e. the city which has a small number of nodes through the matrix, can be a central node in the road network (see Index 3).

Map 8: The Accessibility by the Number of Nodes between Evrey Tow Nodes



Unaizah still comes in the first rank in terms of accessibility to other nodes in the network by 15 nodes. Buraidah comes after Unaizah in the second rank by 18 nodes (see Map 8). This means that Unaizah and Buraidh are considered optimal nodes as central nodes in the network. Also, Al Bukarih comes close to Unaizah and Buraidah by 19 nodes. The second rank has six cities with values ranging between 20 to 30 nodes, and they are respectively: Al Badaeh, Alkhabra, Aiwon Aljwa, Al Methnb, Arbaheh and Aeen Ibnfheed. There are four cities in the third rank with values from 31 to 40, and they are respectively: Arass, Ashmaseh, Riyadh Alkhabra and Algoarh. Al Ammar, Gaebh, Dukhnah and Auglat Al Ssqur also came in the final rank. This evidence confirms that their locations affect their accessibility to other nodes in the network.

Conclusion

Based on the analysis of accessibility, Unaizah kept its place in the first rank through all the measures of accessibility and Buraidh came in the second rank in all measures. In addition, in the final rank there are always marginal nodes on the perimeters of the network such as Algoarh, Al Ammar, Dukhnah, and Auglat Al Ssqur. This means that Unaizah, Buraidah, and the surrounding settlements enjoy good levels of accessibility as a result of their location in the middle of the network.

Through the assessment and the analysis of the accessibility of the transport road network in the Al-Qassim Region in this paper, the transport road network might be able to facilitate the movement of both people and commodities. Also, it is an important element in the transfer of production both within the region and further afield. In addition, this search confirms that the transport road network might be able to contribute to economic development in the Al-Qassim Region.

This paper suggests that the government strengthen the construction of transport infrastructure, especially those high-level traffic axial lines and nodes that have greater influences on the regional accessibility; expand the road network coverage and network size; increase the total number of network edges; and effectively control its high grade network over the Al-Qassim region roads network. Particularly the remote areas like Gaebh, Dhreh, Dukhnah and Auglat Al Ssqur, their development level of

the high-grade road network expected to be further improved is relatively low, which limits the harmonious and even development of the whole region’s development. More prominent is Unaizah and Buraidah's control effect over the whole metropolitan road network. Therefore, settlements like Arass, Al Bukarih, Al Badaeh and Aeen Ibnfheed should be moderately developed to serve as the secondary urban centers in the metropolitan road network. In this way, a multipolarization situation can be formed, which is beneficial to the even development of the metropolitan area spatial accessibility morphology, thus increasing the balance and stability of the whole road network in Al-Qassim region.

Index 1: Accessibility according to the number of direct connections

	Bura	Unai	Aiwo	Algo	Aeen	Gaeb	Arbah	Ashma	AlBad	AlMeth	AlAm	Aras	Dukh	Alkha	Riya	Augl	AlBuk	Total	Rank
Buraidah	-	1	1	-	1	-	1	-	-	-	-	-	-	-	-	-	1	5	2
Unaizah	1	-	1	-	-	-	-	1	1	1	-	-	-	-	-	-	1	6	1
Aiwon Aljwa	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	4	3
Algoarh	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6
Aeen Ibnfheed	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	3	4
Gaebh	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	6
Arbaheh	1	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	3	4
Ashmaseh	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	5
AlBadaeh	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	3	4
AlMethnb	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	5
AlAmmar	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	6
Arass	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	1	-	4	3
Dukhnah	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	6
Alkhabra	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	3	4
Riyadh Alkhabra	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	3	4
Auglat Al Ssqur	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	5
AlBukarih	1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4	3

Index 2: Accessibility according to the Shimbel Index

	Bura	Unai	Aiwo	Algo	Aeen	Gaeb	Arbah	Ashma	AlBad	AlMeth	AlAm	Aras	Dukh	Alkha	Riya	Augl	AlBuk	Total	Rank
Buraidah	-	31	44	80	62	142	27	36	62	66	102	91	149	52	60	214	42	1260	2
Unaizah	31	-	70	106	93	173	67	58	31	35	71	60	118	43	51	205	41	1253	1
Aiwon Aljwa	44	70	-	36	91	171	70	79	101	105	141	130	188	70	78	232	60	1666	9
Algoarh	80	106	36	-	142	222	106	115	118	141	177	147	205	106	114	268	96	2179	13
Aeen Ibnfheed	62	93	91	142	-	80	48	57	124	128	164	153	211	114	122	276	104	1969	12
Gaebh	142	173	171	222	80	-	128	137	204	208	244	233	291	194	202	356	184	3169	16
Arbaheh	27	67	70	106	48	128	-	9	98	102	138	127	185	79	87	241	69	1581	7
Ashmaseh	36	58	79	115	57	137	9	-	78	93	129	118	176	101	109	263	99	1657	8
AlBadaeh	62	31	101	118	124	204	98	78	-	66	102	29	87	12	20	174	22	1328	5
AlMethnb	66	35	105	141	128	208	102	93	66	-	36	95	153	78	86	240	76	1708	10
AlAmmar	102	71	141	177	164	244	138	129	102	36	-	131	189	114	122	276	112	2248	14
Arass	91	60	130	147	153	233	127	118	29	95	131	-	58	41	49	159	51	1717	11
Dukhnah	149	118	188	205	211	291	185	176	87	153	189	58	-	99	107	217	170	2603	15
Alkhabra	52	43	70	106	114	194	79	101	12	78	114	41	99	-	8	162	10	1283	3
Riyadh Alkhabra	60	51	78	114	122	202	87	109	20	86	122	49	107	8	-	154	18	1387	6
Auglat Al Ssqur	214	205	232	268	276	356	241	263	174	240	276	159	217	162	154	-	172	3455	17
AlBukarih	42	41	60	96	104	184	69	99	22	76	112	51	170	10	18	172	-	1326	4

Index 3: Accessibility according to the number of nodes

	Bura	Unai	Aiwo	Algo	Aeen	Gaeb	Arbah	Ashma	AlBad	AlMeth	AlAm	Aras	Dukh	Alkha	Riya	Augl	AlBuk	Total	Rank
Buraidah	-	-	-	1	-	1	-	1	1	1	2	2	3	1	2	3	-	18	2
Unaizah	-	-	-	1	1	2	1	-	-	-	1	1	2	1	2	3	-	15	1
Aiwon Aljwa	-	-	-	-	1	2	1	2	2	1	2	3	4	1	2	3	-	24	5
Algoarh	1	1	-	-	2	3	2	3	3	2	3	4	5	2	3	4	1	39	11
Aeen Ibnfheed	-	1	1	2	-	-	-	1	2	2	3	3	4	2	3	4	1	29	7
Gaebh	1	2	2	3	-	-	1	2	3	3	4	4	5	3	4	5	2	44	13
Arbaheh	-	1	1	2	-	1	-	-	2	2	3	3	4	2	3	4	1	29	7
Ashmaseh	1	-	2	3	1	2	-	-	1	1	2	2	3	3	4	5	2	32	9
AlBadaeh	1	-	2	3	2	3	2	1	-	1	2	-	1	-	1	2	1	22	4
AlMethnb	1	-	1	2	2	3	2	1	1	-	-	2	3	2	3	4	1	28	6
AlAmmar	2	1	2	3	3	4	3	2	2	-	-	3	4	3	4	5	2	41	12
Arass	2	1	3	4	3	4	3	2	-	2	3	-	-	1	-	1	2	31	8
Dukhnah	3	2	4	5	4	5	4	3	1	3	4	-	-	2	1	2	3	46	14
Alkhabra	1	1	1	2	2	3	2	3	-	2	3	1	2	-	-	1	-	24	5
Riyadh Alkhabra	2	2	2	3	3	4	3	4	1	3	4	-	1	-	-	-	1	33	10
Auglat Al Ssqur	3	3	3	4	4	5	4	5	2	4	5	1	2	1	-	-	2	46	14
AlBukarih	-	-	-	1	1	2	1	2	1	1	2	2	3	-	1	2	-	19	3

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تحليل امكانية الوصول لشبكة الطرق بمنطقة القصيم

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الملخص: هناك نقاش واسع حول دور شبكة الطرق وتغيرات مستوى امكانية الوصول لتلك الشبكة على التنمية الاقتصادية الاقليمية،حيث أن أي تحسينات في إمكانية الوصول تؤدي مباشرة إلى تنمية اقتصادية. يهدف هذا البحث إلى تحليل مستوى إمكانية الوصول لشبكة الطرق بمنطقة القصيم من خلال ثلاثة مقاييس وهي على النحو التالي: أولا: قياس إمكانية الوصول من خلال مؤشر شمبل (Shimbel Index)، ثانيا: يتم تحليل إمكانية الوصول من خلال حساب الوصلات المباشرة بين المراكز الحضرية والتي يتم حسابها من خلال مصفوفة درجة الترابط، ثالثا: تحليل إمكانية الوصول من خلال حساب عدد العقد بين كل عقدتين رئيسيتين. أبرز نتائج هذا البحث تؤكد أن امكانية الوصول لشبكة الطرق بمنطقة القصيم قادرة على المساهمة في التنمية الاقتصادية الاقليمية، وكذلك قادرة على تقليل المسافات وجذب المستوطنات المتطرفة إلى المراكز الحضرية الرئيسية.