

# The impact of roads network expansion on agricultural development: a review study of Al-Qassim region in Saudi Arabia

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*Abstract:* - The increase in production in some sectors of the Saudi Arabia's economy over the last three decades has transformed the economy from one of subsistence based on nomadic grazing and traditional agriculture into a strong, modern industrial economy based upon oil revenue and modern agriculture. This change in the economic base has resulted in a drift of population to urban areas, depleting the traditional rural economy of labour. The growth of the population and an increase in economic activity therefore require transportation systems which are able to facilitate the movement of both people and commodities. But when economic activity in a region depends on one type of transport we must examine the level of this network, for instance the Al-Qassim Region is solely dependent on its road transport network. The Al-Qassim Region is considered to be an agricultural area and the transport road network is an important element in the transfer of production both within the region and further afield. Furthermore, the Al-Qassim Region is a metropolitan area, according to a recent estimate; the population density is 12.6 people per square kilometer. This implies a high potential for urban sprawl in the region. To provide information about the ability of the existing road network to contribute to agricultural development, it is necessary to identify the level of transport road network in the Al-Qassim Region through the density and history of the road network.

*Key-Words:* - Transport roads network, Agricultural development, Al-Qassim Region, and Saudi Arabia.

## 1 Introduction

The increase in production in some sectors of the Saudi Arabia's economy over the last twenty years has transformed the economy from one of subsistence based on nomadic grazing and traditional agriculture into a strong, modern industrial economy based upon oil revenue and modern agriculture. This change in the economic base has resulted in a drift of population to urban areas, depleting the traditional rural economy of labour.

The growth of the population and an increase in economic activity therefore require transportation systems which are able to facilitate the movement of both people and commodities. But when economic activity in a region depends on one type of transport we must examine the characteristics of this network, for instance the Al-Qassim Region is solely dependent on its road transport network. There has been rapid development in the Kingdom of Saudi Arabia in different economic sectors in recent years e.g. the estimated production of all cereal in the Kingdom of Saudi Arabia was 2,204,530 tons in 1998, increasing by 12% in 1999. In the Al-Qassim

Region the percentage of production for all cereals increased between 1998 and 1999 by about 46%. Moreover, the numbers of vehicles registered in the Al-Qassim Region in 2000 was 325,535 (including trucks), an increase of about 15% compared with vehicles numbers in 1996 [1].

The Al-Qassim Region is considered to be an agricultural area and the transport road network is an important element in the transfer of production both within the region and further afield. Furthermore, the Al-Qassim Region is a metropolitan area, according to a recent estimate; the population density is 12.6 people per square kilometer. This implies a high potential for urban sprawl in the region. To provide information about the ability of the existing road network to contribute to economic development, it is necessary to identify and evaluate the level of the existence of the road transport network in the Al-Qassim Region.

## 2 The Study Area

The Al-Qassim Region, which is the target of this research, is located in the heart of the Kingdom of Saudi Arabia. It lies approximately 330 kilometres

northwest of the capital, Riyadh, and occupies an area of about 78,500 square kilometres or nearly 4% 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 10 sub-provinces and 155 local centres. According to the last estimate (2005) Al-Qassim's population totalled nearly 980,000, which gives a population density of 12.6 people per square kilometre, while KSA density is 9 people per square kilometre. Moreover, the Al-Qassim Region comes 7th out of 13 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 4289 kilometres linking its cities, towns and villages. The agricultural nature of the region requires an adequate road system in order 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 Ynbuh 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.

### **3 Transport Roads Network and Economic Development**

This section examines the relationship between transport road network and economic development. It would be inappropriate to write this section without providing definitions for terms such as: transport, development, and the relationships between them. 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 [2] 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 [3]. Thatcher [4] 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.

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 [5] "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."

There are theoretical discussions about the relationship between transportation and economic development in many countries, both developed and underdeveloped. Even within the developed countries, the evolution of transport is different and varies from one country to another. According to Hoyle [6] "the relation between transport and development is a subject of considerable theoretical interest and practical importance, and one that has occupied a good deal of attention over many years in both advanced and less-advanced countries". Brooktrios Institution (Washington D.C.) through The Transport Research Program during 1960s yielded a number of important studies on the relationship between transportation and economic development. These included studies of highway development in less-developed countries [7], an analysis of relationships between transport and economic integration in South America [8], and a study of transport problems in India [9]. Also, there is recognition from Geographers that economic development is closely related to the growth of efficient transport systems, and they have evolved

numerous methods of spatial analysis in this context [10].

Based on Mieczkowski [11] "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 [12]. Thus, it seems indisputable that the transport sector is a telling indicator of the country's economic development.

The development of country's road network has an important role to play in the process of economic development. The development of transport being a major factor for agricultural development is evident from the Colombian road project known as "pick and shovel" in 1979. The opinions of the community leaders and the farmers themselves indicate the significance of the road network for development of agriculture sector. The improvement of the transport system resulted in a marked increase of production of potatoes from 500 kg per hectare to 1300-1500 kg, production of peas also increased by 50 per cent and there was a 200 per cent increase in the production of wheat between 1977 and 1979. In addition, the farmers also cited a sharp increase in land values from two to ten times at different locations after the start of the road construction programme [13].

In Sub-Saharan Africa there is an impressive array of projects underway in many parts of region. Governments across the length and breadth of Sub-Saharan Africa are under unprecedented pressure to develop their road networks. According to Choudhury [14] the development of a better road network is a prerequisite to improve Africa's economic performance. With roads accounting for over 80 per cent of all travel and freight movement, the development of a better road network is vital to boosting trade and for increasing access to rural areas. This is also expressed by Beimborn et al. [15], with the highways promoting economic growth by increasing access to new areas, which in turn may provide access to skilled labour markets and inexpensive land for starting new businesses. Accordingly the increasing accessibility of new areas will make them attractive for development.

In the Kingdom of Saudi Arabia, the position is also similar to some countries where transport development 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. In the past, and before using new inputs such as improved seeds, fertilizers and irrigation, every region had to cultivate and consume its own products; in other word 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 the 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 [16]. 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 1960s, such developments were impossible because of the dependence upon camels for transportation. Subsequently, the region has become more involved in internal trade and also exports to the Gulf countries, being connected by the new road network, after the first plan development in the beginning of 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.

#### **4 The History of Road Network in Al-Qassim Region**

As mentioned before, the 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 conjunction with the Kingdom's five-year plans, the MOC prepared its own comprehensive plan known as the Five-Year Road Programme. This programme 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 [17].

The construction of 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 [18]. 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 [19]. 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 roads network at the end of second development plan being 1306 km [20].

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. 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. Abalkhail [21] 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.

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 [22] states that during this stage the MOC has covered operation, maintenance projects and 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. The total length of roads in the region is 4289 km [23].

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:

#### **4.1 Al-Qassim-Riyadh Expressway**

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 47 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 [24].

#### **4.2 Old Al-Qassim-Madinah Road**

This road is classified as single-carriageway, having one 5-metre wide lane without a central reservation and is about 500 km in length. It is located in the west of the Al-Qassim Region and passes through a number of towns and villages such as Hnakeh, Batra and Auglat Asgur. The importance of this road derives from the fact that Madinah is the site of the Mosque of the prophet Mohammed, which the majority of pilgrims wish to visit before or after the performance of the Hajj in Makkah. For this reason the need for an expressway was felt essential and the Ministry of Communications constructed the Al-Qassim-Madinah expressway [25].

#### **4.3 Al-Qassim-Madinah Expressway**

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 [26]. Although this road runs parallel to the old one, it is shorter and reduces the distance between Al-Qassim and Madinah by 55 km.

#### **4.4 Al-Qassim-Hail Expressway**

This road runs from Al-Qassim towards Hail, passing through Sharri for a distance of 284 km. It is classified as highway and is located in the north of the Al-Qassim Region. 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 [27]. For this reason, the Ministry of Communications has finished new expressway between Al-Qassim and Hail regions.

#### **4.5 King Abd Alaziz Road**

This road links Buraidah and Unaizah, which are both large cities in the Al-Qassim Region, and extends to Muthnab (about 60 km) [28].

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.

### **5 Analysis of Transport Network**

Network analysis is considered an important feature in geographical studies of transportation network [29]. However, to understand the broad skeleton of the road network it is useful to reduce the actual network to a topological network.

A topological map or graph, as it is commonly called, reduces a transport network into its simplest form to help us to understand the characteristics of transportation networks more easily [30]. Briggs [31] has said: "Topology is a form of geometry concerned with the positions and relationships between points and lines and areas and not with the distance between points, the straightness of lines or the size of areas". The elements of topological networks consist of a series of points, usually called as 'Nodes' or 'Vertices' which are usually linked together by lines, usually referred to as 'Links', 'Edges', and 'Arcs' which often enclose areas of space [32]. After the transport system is reduced to a topological network several measures and indices are used to analyze the network efficiency, one of them is:

Density of Roads

The measure of road density is a statistical measure that may aid, and add precision to the description of networks [33]. Furthermore, the density of roads is an important index reflecting the economic development of a region [34].

The higher index of Density is meaning the more networks are developed. The density of a road network is an important measure in the analysis of a road network in that it reflects the economic development of any region. Where the density of a road network is high, this means that the region has enough roads, but where it is low it may mean that there are some parts of the region that need more roads.

The density of the road transport network in the Al-Qassim Region is about 11. km per 1000 km<sup>2</sup> and this is considered low compared to the mean of international density which can be more than 105. Furthermore, the density of the road transport network in the populated part, which lies in the heart of Al-Qassim Region, equates to 17.67 km per 1000 km<sup>2</sup>. This means that the areas far from the heart of the Al-Qassim Region need more roads. To compare with other regions, for example the Al-Madinah Region's density was calculated at about 13.30 and the density of Eastern Region equated to 5.47.

### **6 Conclusion**

Through this paper, it has become clear that the road transport network plays a critical role in the distribution of settlements. Moreover, it also plays a role in the allocation of agricultural, industrial and trade areas in the Al-Qassim Region.

According to the analysis of the density of the road transport network in the Al-Qassim Region, the density of the road network (11.41 km per 1000 km<sup>2</sup>) is low compared with the mean of international density, which can be more than 105. However, the density of the road network in the heart of the Al-Qassim Region equates to 17.67 km per 1000 km<sup>2</sup>, which means that the remote areas in the heart of the region need more roads.

Through the analysis of the density and the history 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 paper confirms that, the transport road network might be able to contribute to the agricultural development in the Al-Qassim Region.

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