

## **An Analysis of Road Infrastructure on Physical and Human Development of Metropolitan Cities of Punjab**

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**Abstract:** Social infrastructure is the backbone of any country's economy. The Pakistan's major metropolitan cities which lie in Punjab province Faisalabad, Lahore, Gujranwala, Sialkot, Rawalpindi and Multan have major industries. For enhancing interaction of goods and services between these cities, metalled roads and highways are required. Roads will also link big cities with rural areas and this will help smooth flow of social and economic infrastructure to every part of the country will come into being. Communication gap will decrease and reduction in transportation cost will promote industrial development. As low type roads and farm to market roads can increase growth so government should look upon their maintenance. National highways and motorways reduce the time of travel so they should also be considered as a priority. These kinds of activities generate employment opportunities, so it should be regulated. This study attempts to explain the impact of road infrastructure on regional connectivity and poverty reduction of Punjab province in Pakistan by using time series data of variables national highways, farm to market roads, motorways, sugar cess roads, provincial roads and low type roads of Punjab province between 1990 and 2015. Literacy rate is used as an indicator of human development index (HDI) and Maternal mortality rate as an indicator of physical quality of life index (PQLI) of Punjab province. The findings of the study showed that road infrastructure is affecting positively to both physical and human development indicators in the province Punjab. Econometrics analysis also showed that the variables like farm to market roads, sugar cess roads and low type roads have both short run and long run impact upon increasing literacy rate whereas provincial roads have their impact only in short run impact on the economic development and prosperity of the province. In case of maternal mortality rate Model, the variables i.e. all the independent variables showing negative impact of on dependent variable but farm

## 90 An Analysis of Road Infrastructure on Physical and Human Development of Metropolitan Cities of Punjab

to market roads and provincial roads in short run and sugar cess roads and low type roads it in long run.

**Keywords:** Infrastructure, Roads, Poverty, Human Development.

### **1: Introduction**

We live in a world characterized by incredible economic inequality and extreme poverty and this poverty is the grave concern for the whole world. From the last two decades the economic conditions of the world are diverting from decreasing trend to increasing trend so poverty is decreasing. Poverty is the lack of certain capabilities which ill-treated, hungry, depressed and inferior people can manage and bear with patience and these are 1. Economic capabilities (income and assets), 2. Human capabilities (health care, nutrition, education, clean water and hygienic living conditions), 3. Political capabilities (human rights participation in policy making and decision making), 4. Socio-cultural capabilities (participation as the valued member of the community with social status and dignity), 5. Protective capabilities (food insecurity, crime, war and conflict). Lack of all above mentioned capabilities are the multidimensions of poverty. According to the UN Development reports more than 1.6 billion people are living in multidimensional poverty and out of them 52% live in South Asia. Up to 2030 the world will have to spend at least \$57 trillion to build roads, rails, power plants, ports and telecommunication infrastructure which the world economy need. This all building is required to sustain high growth and poverty reduction.

If we talk about Infrastructure than we will come to know that it is the basic physical system required by a nation. It constitutes road networks, communication, sewage, water and electric, educational and health systems. These systems need high-cost of investments; however, they are vital for a country's economic development and prosperity. Projects related to infrastructure improvements are funded publicly, privately or through public private partnership.

Investments on infrastructure are deployed in the belief that they will inevitably lead to poverty reduction and income generation. Among infrastructure, roads are considered of first interest to reduce poverty due to the widely accepted consensus that transport infrastructure has a significant, positive and substantial impact on economic growth and poverty as it enhances the connectivity of isolated and remote areas. Gachassin (2009) found in his studies that road infrastructure has a direct impact upon the labor activity and it reduces poverty by giving jobs to the poor. The study also emphasizes upon the positive impact on the probability to get involved in farming activities and lack of developed and dense roads cannot kill poverty. To have an excess to other institutions of the country and to markets which is necessary for growth and development they will have to focus on road infrastructure otherwise that country will only be restricted to the agriculture and no industrial activity will be done. However, the poor's share in infrastructure is often not large enough to significantly reduce poverty and the benefits from road extension could be greater for landholdings or the rich than poor. The relevant question to ask is whether the benefits of a hypothetical road project are sufficiently large and distributed progressively enough to reduce overall poverty, with benefits accruing more to the poor than the non-poor. Though, rural roads are usually regarded as more important in creating job opportunities, facilitating empowerment, and enhancing security. Thus, an efficient road network could reduce the time and cost of movement of goods within a country and equally facilitates connection among the different parts of the country which enhances interaction.

Pakistan lies in South Asia and its ever first multidimensional poverty report was launched on June 2016. According to this report almost 39% of Pakistan lives in multidimensional poverty, with the highest rate of poverty in FATA and Baluchistan. This report showed a strong decline in poverty rates from 55% to 39% from 2004 to 2015. Poverty in urban areas is 9.3% as compared to 54.6% in rural areas. In Punjab, poverty rate is 31%. Lack of

## 92 An Analysis of Road Infrastructure on Physical and Human Development of Metropolitan Cities of Punjab

education, lack of health facilities and poor income in rural areas are somehow controlled and decreased.

With the collaboration of ADB Pakistan signed a project on October 2002 for Punjab province and this project consists of construction of roads included 302 km of rehabilitated provincial highways and 1100 km of rehabilitated and improved Rural Access Roads (RARs). This project was done mostly in lower and middle Punjab, where the poverty ratio was about 38%. According to poverty impact assessment undertaken in connection with the project, the project was to directly benefit about 2.6 million road users of which an estimated 1 million were poor. ADB provided a loan \$150 million from its capital resources and from which \$82.8 million was disbursed. In those days the Punjab province did not have proper connectivity and many sections of the provincial road networks were in poor condition. The provincial government of Punjab took measures to minimize institutional constraints and give attention to some key road sector policy issues, especially road maintenance and private sector involvement. The project targeted to facilitate trade by improving important provincial highways, providing employment opportunities, improvement in rural roads for better access to markets and reduce rural poverty, create funding mechanism for road maintenance, increase private sector involvement in road maintenance, improve asset management by increasing budgeting and planning capacity and support of organizational reforms and strengthening of institutions of Punjab communication and works department (CWD).

During this project Pakistan was in macroeconomic instability and improvement to physical infrastructure were expected to help reduction in Pakistan high trade cost. Up to 2008 50% progress had been done and by mid-2011 CWD had managed to complete 92% of the original provincial road component and about 29% of RAR component.

This report found that expected improvement in sustainable economic development and poverty reduction would be done

because these projects would increase gross regional product by 2015.

Seven provincial highways were constructed which were following.

1.	Pindi Bhatia - Chiniot	36 km
2.	Jhang - Shorkot	37 km
3.	Kabirwala – Shorkot	7 km
4.	Kabirwala - Mahni sial	14 km
5.	Kamal pur-Chiniot-Sargodha	73 km
6.	Sargodha - Khushab	44 km
7.	Jhang-Toba tek singh – Chichawatni	91 km

These were the 29% of the total project. It is also shocking that this project takes place in Punjab which has country's provincial road network accounted for about 54% of Pakistan's total share. Similarly, Pakistan signed CPEC with china in 2013. To fulfill this project china firstly gave 46\$ billion. 11\$ billion were invested on the construction of highways and motorways in whole of Pakistan which connect Pakistan internally and with china. Now the investment in the form of loan from china has reached \$62 billion. We will have to return this loan in 20 years but if we fail to do so than we will have to pay interest on it.

### **1.1: Research Questions and Problem Statement**

It is said that poverty reduction is directly related to the provision of social infrastructure so how this research will test this issue. Punjab government focuses upon providing metro buses and road networks more than educational and health infrastructure, so is this satisfactory to invest in these projects more than others. Are road infrastructures exerts direct impact on economic development by increasing literacy rate and decreasing maternal mortality rate of the people? If yes than how? It is to find the link between road infrastructure and poverty reduction. Is there any link between roads and decreasing poverty trend? Different projects initiated by Punjab government are not feasible for the people at that particular time because there is a need of necessity not luxury. Education and health are the necessities of the people so government should invest more in these institutions. Here jobs opportunities and

positive linkages are also necessities. Will these kinds of projects create positive linkages and provide atmosphere for education, health and other businesses? In Pakistan these kinds of researches and menus are essential to expose the main aim of investments which are mostly deployed by politicians to get political fame not to achieve the public rights. Planning and development department of the Punjab must conduct these researches for proper channelizing funds issued by government.

### **1.2: Objectives of the study**

The main objectives of this research are:

- To check out the role played by road networks on poverty reduction and economic growth of Punjab.
- To find that how much these metalled roads facilitate microeconomic indicators of growth including business efficiency, domestic and international trade and global mobile activity.

### **1.3: Hypothesis**

**H<sub>1</sub>:** Road infrastructure contributes to economic development.

**H<sub>2</sub>:** There is a nexus between road infrastructure, regional connectivity and poverty reduction.

## **2: Literature review**

Oliva (2017) explained that road networks are the main pillars of regional connectivity and provide the link between national markets, sustain economic growth, promote trade and fulfill the basic needs of the people. It focuses on the good transportation which requires good governance, competency and availability of funds. According to the policy and research perspectives the transport infrastructure is a big push to drive economic growth, structure transformation and urbanization. It creates positive externalities and leads to reduction in transport cost. These impacts lead to an increase welfare and income which lowers poverty. It also creates negative externalities which are

deforestation and biodiversity loss. Increased traffic on new roads leads to air pollution and detrimental health impacts.

Emerson et al. (2017) estimated and proved the direct link of investment in infrastructure with poverty reduction in Brazil. It is proved that investment and transport sector has a positive effect on the Brazilian economic performance by contributing in income inequality reduction. There is a long term relation between infrastructure and economic growth.

Noyolitzin (2015) showed that on average every additional kilometer of highway ( $km/100km^2$ ) poverty reduces in 0.4% points. This study on transportation infrastructure shows that those countries which has greater rate of urbanization, highways are important for rural development and poverty reduction. It also shows that highways have more impact during periods of economic contraction. Some models shows that when there is an economic contraction then highway becomes more important in reducing poverty.

Le-Jie (2013) found from the economy of China that the transportation infrastructure has a positive impact upon poverty reduction. It increases the income of poor and alleviates poverty. In this article net PCI of poor villages is a dependent variable whereas road infrastructure is an independent variable.

Rudra and Tapan (2012) examined the impact of transportation infrastructure on Indian economy by using Vector Error Correction Model (VECM). By using the period 1970-2010 they found bidirectional causality between road transportation and economic growth and same between GPCF (gross domestic capital formation) and economic growth and concluded that sustainable transport policies can sustain Indian economic growth.

Mehmet and Hakan (2012) investigated the relationship between transportation and per capita income of EU-15 countries. By using panel data of the period 1970-2008, they found that per capita income causes change in transportation and transportation cause change in per capita income of low per capita income countries of Europe. The low income countries were Portugal, Greece and Italy. They proved that both are directly related to each other.

Seetanah et al., (2009) concluded that transport infrastructure and communication infrastructure are the best and worth taking tools to fight urban poverty. Education, road infrastructure and health services have a 5% impact upon poverty reduction.

Chinese (2008) conducted a study based on panel data and time series data of 1994-2002 and 1978-2002 of china. They examined that transport infrastructure increased growth level and alleviate poverty in East and Central china. By using granger test they found that investment on transport especially provision of roads in poor areas has a positive impact upon growth and poverty reduction, it should be the priority of government.

Pravakar and Ranjan (2008) examined output capability of infrastructure by using Pedroni's panel cointegration method for four south Asian countries which are India, Pakistan, Bangladesh and Sri Lanka for the period 1980-2005. The results of this study shows that fixed capital formation, export, labor force and expenditure on human capital has a positive impact on output of the countries. This proves that infrastructure contributes positively to increase output and vice versa. Results show that there is a bidirectional causality between infrastructure and output but a unidirectional causality found from infrastructure to per capita income. It means that infrastructure is considered a main component of increasing per capita income.

Fan and Chan-Kang (2005) showed the positive link between road infrastructure, economic growth and poverty reduction. The results showed that low quality roads which are mostly in villages contribute much greater than high quality roads in economic growth. Low quality roads generate agricultural GDP and reduce poverty by providing access to the market. So, government should invest more on low quality roads than on high quality roads. There raise poor above poverty line per Yuan invested than on high quality roads.

## **Research Methodology**

### **3.1 Data and methodology**



The data on the following variables have been collected to find the desired relationship: literacy rate, maternal mortality rate, roads length in which there are farm to market roads, national highways, motorway, sugar cess roads, provincial roads and low type roads from 1990-2016 of Punjab. The data of roads and maternal mortality rate is collected from Punjab bureau of statistics whereas data of literacy rate is collected from economic survey of Pakistan. By using Vector Error Correction Methodology (VECM), which is a causality analysis, to check the causal relationship between variables and also their long run and short run impact upon dependent variables. Firstly, unit root test using dickey-fuller, augmented dickey-fuller and Philips Peron tests are applied to justify the stationarity status. After checking stationarity status it is able to test the models. If all the variables are stationary at level then OLS is used for estimation. If all the variables are stationary of order “1” than it will be applied cointegration tests. If study find cointegration among variables than it will be applied VECM methodology. If there will be no cointegration than it will be applied VAR methodology. Study found cointegration among variables so it is applied VECM technique.

### 3.2 Statistical Analysis

This section explains the model used in the study for finding the impact of roads upon economic development using literacy rate as an indicator of development.

#### Model 1

$$Lr = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

$X_1 = \text{farm to market roads}$   
 $X_2 = \text{provincial roads}$   
 $X_3 = \text{Sugar cess roads}$   
 $X_4 = \text{Low type roads}$   
 $e = \text{error term}$

Here in this equation Lr (literacy rate) is the dependent variable and it is going to analyze the impacts of different types of length of roads on literacy rate of Punjab. These roads are high type roads including farm to market roads, provincial roads, motorways, national highways, sugar cess roads and low type roads. Here  $\alpha$  is

the constant and  $\beta_1, \beta_2, \beta_3$  and  $\beta_4$  are the slop effects of independent variables.

Similarly, there is another equation through which will test the impact of roads on per capita income of the people. This model will tell about the better living standard of the people because if the effect will be positive than it means infrastructure decreases maternal mortality rate (Mm) and directly increases the living standard.

### **Model 2**

$$Mm = \partial + C_1X_1 + C_2X_2 + C_3X_3 + C_4X_4 + e$$

In this equation the dependent variable is  $Mm$  and independent variables are the same as above the length of different types of roads. Here  $\partial$  is the constant and  $C_1, C_2, C_3$  and  $C_4$  are the slope effects of the independent variables. By applying VECM causality analysis and then Wald tests, the long run as well as short run impact over dependent variables has been found.

### **3.3 Description of variables**

In this statistical analysis there are many variables. Literacy rate is an indicator of HDI (human development index) and Maternal mortality rate is an indicator of PQLI (physical quality of life index) of Punjab province. Both these indexes are used to determine the economic development and reduction in poverty. That's why literacy rate and maternal mortality rate are used to determine development and poverty reduction. There are independent variables used in model equations and are following: Farm to market roads, motorways, national highways, provincial roads, sugar cess roads and low type roads. Thus farm to market roads are the roads which link rural areas to markets and mandis of the districts. Motorways are the luxury roads which links major cities of the province. Currently, motorway is only connected Islamabad to Lahore and to Faisalabad. The projects initiated under CPEC also has the construction of motorways throughout the region. National highways are the highways through which

transport of certain goods takes place in whole Pakistan e.g. GT road. Sugar cess roads are the roads built for sugar can transportation to the mills. Provincial roads are all the public roads which are maintain for public flow. All these above mentioned are the high type roads. Low type roads are the roads of low category. These types of roads are mostly present in rural areas. This study has not used the data of motorways and national highways because of singular matrix.

#### 4. Estimation of Model 1

All the variables are non-stationary at level but stationary at 1<sup>st</sup> difference. So Johansson co-integration test will be applied because the variables are stationary at 1<sup>st</sup> difference.

Results shows that there are 2 co-integrated equations which proves that variables are co-integrated with each other. So VECM methodology will be applied because there is co-integration among variables. If there will be no cointegration among variables than according to rules VAR model is apply. The R-square value is 66.03% which is showing the accuracy of the model.

##### 4.1.1 Coefficient diagnostics test results

**Table 01:** Wald test results where literacy rate is dependent variable

Independent variables (length in km)	p-chi-square value
Farm to market roads	19.94%
Provincial roads	0.23%
Sugar cess roads	83.12%
Low type roads	88.92%

If the p-chi square value of the Wald test is more than 5% than it has a long run relationship otherwise it has a short run relationship with the dependent variable. According to coefficient diagnostics test (Wald test), results shows that farm to market roads, sugar cess roads and low type roads have long run positive relationship with literacy rate whereas provincial roads have short run positive

relationship with it. Wald tests proved their long run as well as short run impact upon dependent variable.

**4.1.2. Residual diagnostics test results**

After all of this, to check out the correctness of model hetroskedasticity test having p chi-square value is 49.30%, serial correlation test having p chi-square value is 48.07% and jarque bara test having p-value is 0% and jarque bara value is 50.28% are applied to check the specification. They shows that the model is correct because their values are more than 5%. It is obvious that the roads share is low but exist and also has an indirect impact. Literacy rate has an increasing trend and the roads investment is also increasing day by day. This whole scenario is explained in blew mentioned figure. It is explaining that transportation investment has an indirect impact upon economic growth and development. It creates positive externalities and have socio economic impact over wellbeing. This will initiate better living standard.

**4.2. Estimation of Model 2**

This is another equation in which maternal mortality rate is dependent variable and farm to market roads, provincial roads, sugar cess roads and low type roads are independent variables.

After applying Johansson cointegration test, because the data is stationary at 1<sup>st</sup> difference, there are 2 cointegrating equations. Because of rules there is required to apply VECM methodology. Wald tests will prove the long run and short run impact of independent variables. This model is 94.98 % correct according to R-square value.

**4.2.1. Coefficient diagnostics test results**

**Table-02:** Wald test results where maternal mortality rate is dependent variable

<b>Independent variables (length in Km)</b>	<b>p-chi-square value</b>
Farm to market roads	2.85%
Provincial roads	0.07%

Sugar cess roads	5.67%
Low type roads	78.12%

According to Wald test results the variables which has p-value more than 5% has long run relationship with the dependent variable. So, farm to market roads and provincial roads have short run relationship with decreasing maternal mortality rate whereas. Sugar cess roads and low type roads have long run relationship with it.

#### **4.2.2. Residual diagnostics test results**

After applying heteroskedasticity test the p chi-square value is 99.60%. Serial correlation test p chi-square value is 0.23%. jarque bera test p-value is 65.73% and jarque bera value is 83.91%. All these tests proved the appropriateness of the model. All these values are more than 5% which prove that there is no serial correlation, no heteroskedasticity and there is normality in the model. All the above mentioned values are saying that the model is perfect. So results show that maternal mortality rate is also depending upon the road infrastructure. With the construction of different types of roads maternal mortality rate is decreasing and the decrease in it increases the living standard of the people.

#### **5: Conclusion and Recommendations**

Transportation have a positive impact upon microeconomic drivers of productivity. It increases business efficiency, business investment, labor market competition, domestic and international trade and globally mobile activity. These microeconomic drivers and externalities decreases poverty ratio by increasing job opportunities for unemployed and increasing literacy rate increases the living standard of the people. The results of the estimated model proved the alternative hypotheses:

1. Road infrastructure contributes to economic development by increasing literacy rate and decreasing maternal mortality rate.
2. There is a nexus between road infrastructure, regional development and poverty reduction

Econometrics analysis shows that farm to market roads, sugar cess roads and low type roads have long run impact upon increasing

## 102 An Analysis of Road Infrastructure on Physical and Human Development of Metropolitan Cities of Punjab

literacy rate whereas provincial roads have only short run impact upon improving this indicator. In the case of maternal mortality rate, it is observed that farm to market roads and provincial roads have decreased maternal mortality rate in short run whereas sugar cess roads and low type roads decreases it in long run.

Overall on the basis of these findings the study recommends that infrastructure contributes to human and physical capital development therefore initiatives for building road networks should be taken to improve education and health facilities. A demand side theory of infrastructure says that commercial, public and social infrastructures are the demand of the public. Some are used for consumption purpose and are used nonrivalrously, others create social value and are the primary sources of social benefits and the third category is used as an input for getting massive output. One of the basic purposes of infrastructure is that it creates a spill over environment where new and unprecedented innovations, knowledge and social capital can be developed. The poverty trend of Pakistan is decreasing because of development. So it is concluded that roads are directly and indirectly decreasing poverty by increasing economic development.

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