Impact of Rural Infrastructure on Development of Pakistan: A District Level Analysis

Submitted by

Naeem Asghar

Supervised by

Dr. Nasir Iqbal

Director Research BISP

A thesis submitted to Pakistan Institute of Development Economics, Islamabad, in partial fulfillment of the requirements for the award of the degree of Master of Philosophy in Economics

DEPARTMENT OF ECONOMICS

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS (PIDE), ISLAMABAD

2015

AUTHORSHIP STATEMENT

*I **Naeem Asghar** declare and affirm on oath that I myself have authored this M.Phil. Thesis with my own work and means, and I have not used any further means except those I have explicitly mentioned in this report. All items copied from internet or other written sources have been properly mentioned in quotation marks and with a reference to the source of citation.*

DEDICATION

This piece of research is dedicated to my parents for their unending support to me in whole this journey.

ACKNOWLEDGEMENT

Bismillah Hirrahman Nirraheem, first of all I would say thanks to my Lord who has shown countless blessing on me and provided me the chance to study in this esteemed institution. After that I would say bundle of thanks to my parents whose unmatched and unconditional support enabled me to successfully achieve this milestone. I would say a lot of thanks to my supervisor Dr. Nasir Iqbal for their continuous and detailed guidance without which I would have never been able to achieve this milestone. Moreover, I would pay my tribute to my brother and sisters who always stood by me during my stay at PIDE and assisted me in achieving my goals. After that I would say thanks to all my class fellows who's timely support acted as foreign aid for me especially I would say thanks to Mr. Zafar Iqbal, Naveed Mahmood, Wajid Ali, Samiullah Khattak, Muhammad Attaul Islam Abrar, Choudhry Liaqat Ali, Zaheer Ahmad Sb, Yousaf Dar, Haseen Shah, Muhsin Ali, G.M Sb, Malik Khafayat Ullah Awan, Hamid Hussain and Madam Tahira and my old class fellows Nabiya Tehreem, Farrukh Mahmood, Saud Ahmad and Muhammad Moin Maqsood. Finally I would say a bundle of thanks to my friends Usman Yasin, Muhammad Ali Chohan, Islahudeen, Wassif Hussain, Muhammad Amir, Rehaan Rao, Muhammad Waqas, Samar Ali and one and only Tahir Bhai for their moral support and comments. I would say thanks to my college friends Syed Jalal, Wiqar Ahmad and Naveed Baigh for their countless prayers. In the end I would say thanks to all those who have not been mentioned above and who have supported me during my stay at PIDE. Thanks to all of you for lending your unending support to me, you guys just made me achieve this. ***Jazakallah****……*

Naeem Asghar

TABLE Of CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

PMDGR	Pakistan Millennium Development Goal Report 2013
TOT	Terms of Trade
CAGR	Compound Annual Growth Rate
PSLM	Pakistan Social and Living Standard Measurement
HHS	Household Size
HHHA	Household Head Age
MFI	Micro Finance Institutions
PCA	Principal Component Analysis
R & D	Research and Development
RSP	Rural Support Program
PPAF	Pakistan Poverty Alleviation Fund
BISP	Benazir Income Support Program
HCR	Headcount Ratio

ABSTRACT

Poverty is primarily a rural phenomenon in developing countries like Pakistan. Poverty in rural areas is relatively high (46%) then the urban areas of Pakistan (18%). This study investigates the empirical linkages between rural infrastructure and poverty at district levels in Pakistan using penal data over the period 2003 to 2008. There are two main sources of data, which are used in study: Pakistan Mouza Statistics (2003 and 2008) and Pakistan Social and Living Standard Measurement PSLM (2004-05 and 2008-09). We have used fixed effect model to estimate the impact of rural infrastructure on rural poverty in Pakistan. The empirical results show that physical infrastructure (electrification, rural road and irrigational facilities) have a negative and significant impact on rural poverty both at national and provincial level. Soft infrastructure, also have negative and significant impact on rural poverty across all provinces except Baluchistan. This analysis shows that along with physical infrastructure we need to pay more attention to soft infrastructure. The quality of soft infrastructure needs to be improved, to reap the positive benefits associated with human capital for development. Absence of proper schooling, health institution and physical infrastructure facilities (like roads, electrification and irrigational facilities) may lead to poverty.

CHAPTER 1

INTRODUCTION

1.1 Background

Public investment plays significant role in eliminating poverty and promoting economic development, in both developed and developing countries. Public investment opens doors of opportunity for marginalized segments of the society, through expansion of farm and nonfarm activities. Public sector investment, especially investment in infrastructure have the highest potential in promoting economic development of the country through industrialization, geographical access, better sources of communication and availability of efficient and mobile labor force. Non-availability of these facilities creates bottlenecks in the process of economic development and therefore leads to poverty.

The role of infrastructure in promoting economic development is widely acknowledged in literature (Ali and Pernia 2003, Fan *et. al*. 2000 and 2004, Kwon 2005, Seethanah *et. al.* 2009, Khandker and Koolwal 2010 and Ahmad 2013). Infrastructure facilities can be classified into two main branches: physical and soft infrastructure. Physical infrastructure includes electrification, paved roads and irrigational facilities, whereas soft infrastructure includes education and health facilities. Development of physical infrastructure, acts as a key factor for achieving competitiveness in manufacturing and agriculture through promoting production facilities, reducing transactional cost and by providing better employment opportunities for the poor's (Sahoo *et. al.* 2010 and Fan *et. al.* 2004). This study terms physical infrastructure as a pre-requisite for development of soft infrastructure and human capital. Majumder (2012) termed infrastructure as geographical capital of India, he argued that better infrastructure leads to changes in socio-economic characteristics of the society (reduction of poverty) through increased access to factor and product markets, industrialization, and higher labor mobility.

Physical infrastructure is a main facilitator towards poverty reduction, higher density of physical infrastructure leads to reduced poverty through direct (creation of new jobs) and indirect effects (by smoothing the functions of all the socio-economic variables) Kwon (2005). Soft infrastructure performs a better role in reducing poverty as compared to physical infrastructure through better human capital formation in Nigeria Ogun (2010). Public investment in rural infrastructure facilities (like rural electrification, paved road, irrigational, health and education) are helpful in reducing the miseries of poor people in Pakistan through higher productivity and improved access to social services Arif and Iqbal (2009), Nadeem *et. al*. (2011), Arif and Farooq (2011), Ahmad and Malik (2012) and Ahmad (2013).

1.2 Motivation

There are two notable features of rural areas of Pakistan. First feature of rural areas is that, rural poverty is very high as compared to urban poverty. In Pakistan the average level of rural poverty is 46%. Apart from this high level of poverty, we can also note that magnitude of poverty differs within regions and across provinces for example average rural poverty in Pakistan is 46% as compared to urban poverty which is 18% only. The second main attribute of rural areas is that availability of infrastructure facilities is very low in rural areas of Pakistan.

In intera-provincial disparities, Baluchistan has the biggest level of disparity, where almost three-quarters (almost 72%) of rural population is poor, on the other hand, urban poverty in Baluchistan is 29% only (which is significantly lower than the rural poverty and can be explained on the basis of lower rural infrastructure facilities). In this urban rural disparity, Sindh finds second position where 46% of rural households are poor in contrast to 20% households in urban areas. Rural-urban disparity shows similar trends in KPK, where 43% of rural households are poor on the contrary 18% of the urban households are poor in KPK. In Punjab almost 28% of rural households are poor as compared to 10% in urban areas. The latest

statistics (which are presented in Table no. 1.1) clearly points towards existence of link between rural infrastructure and poverty which needs to further investigated.

Table 1.1 Rural Poverty and Infrastructure

		Pakistan	Baluchistan	KPK	Punjab	Sindh
Poverty	Urban	18	29	18	10	20
	Rural	46	72	43	28	46
Infrastructur	Soft	32.3	22.2	43.9	29.0	35.4
	Physical	63.1	30.1	60.4	74.2	74.0
Electrified Mouzas		84.9	55.6	88.8	94.4	87.9
Irrigational Facility		49.6	9.7	27.9	63.1	86.1
Metal Roads		68.2	32.0	69.5	82.7	70.0

Sources: Authors constructed this Table basing on information of Pakistan Mouza Statistics 2008 and study of Naveed and Ali (2012)

In Pakistan and if we rate the provinces in percentage deprivation, we found Baluchistan to be having least average value of infrastructure facility among provinces and therefore, it is the leading in poverty, with almost 52% of the population living below poverty line. Sindh maintains second position, with almost 33% of the population living below the poverty line, though it holds better infrastructure facilities then KPK. Similarly, KPK scored third position among provinces, with around 31% of its population living below the poverty line. This better position of KPK is due to least rural urban disparity present in KPK, as compared to Sindh. Punjab on the other hand is the least poor province of Pakistan with almost 19% of its population living below the poverty line. This better position of Punjab could be explained on the basis of better holding of infrastructure facilities.

Furthermore, the current government has realized that the modernization of infrastructure facilities is a pre-requisite for the faster development of the country. Therefore, in Vision 2025 plans, preference has been given to the exploration of indigenous and cost effective sources of electricity generation. In addition to this the government wants to improve

the regional connectivity through establishment of efficient and integrated transportation and communication system. For achieving higher levels of human capital, government of Pakistan plans to increase the primary schools facilities, increase the higher education coverage from 7% to 12%. Furthermore the government is working on reducing the dropout ratio.

This discussion reveals that there might be some links between rural poverty and infrastructure in Pakistan. The literature, linking rural infrastructure and poverty is quite scanty in Pakistan. However in recent past, few attempts were made to investigate the linkages between rural infrastructure and poverty in Pakistan. For example, Arif and Iqbal (2009), Nadeem *et. al*. (2011), Arif and Farooq (2011), Ahmad and Malik (2012) and Ahmad (2013). The available studies either used time series data or cross-sectional data for estimating these links. In Pakistan, neither a single study has used panel data for exploring these links, though we have major evidence from countries like Bangladesh, India and China where panel data has successfully explained this rural infrastructure poverty nexus. So, this study fills the gap by using panel data for tracing the linkages between rural infrastructure and poverty at districts level in Pakistan.

1.3 Objectives

The core objective of the study is to investigate the impact of rural infrastructure on economic development (rural poverty) at district level in Pakistan, using the panel data from Mouza Statistics and Pakistan Social and Living Standard Measurement (PSLM). More specifically we have following objectives:

- Analyse the impact of physical and soft infrastructure on rural poverty in Pakistan.
- Development of physical infrastructure index
- Development of soft infrastructure index
- Examine the pattern of infrastructure development across regions.

1.4 Methodology

Empirical analysis is based on panel of 83 districts from four provinces (Baluchistan, KPK, Punjab, and Sindh) of Pakistan. As we are dealing with household and district-level panel data, we would employ panel estimation technique of Fixed Effect. As, fixed effect model has a better tendency to capture the unobserved/unmeasured agro-climatic and location factors of these rural areas, which differ across the cross sections but remains constant over time within a cross-section (districts in our case).

1.5 Structure of Study

This study has been divided in into 6 chapters. Chapter 1 contains background, motivation and objectives of the study. In chapter 2, we have presented the dynamics of poverty and infrastructure growth. Chapter 3 investigates the details of literature reviewed, chapter 4 explains the data, theoretical framework and explores status of infrastructure development in Pakistan through descriptive analysis. Chapter 5 contains discussion regarding estimated results. Finally, chapter 6 captures conclusion and policy recommendations. References are presented at the end of the study.

CHAPTER 2

POVERTY AND INFRASTRUCTURE AT A GLANCE

2.1 Introduction

In this chapter, we explore the prevalence of rural poverty and availability of infrastructure in depth. In section 2.2, we present, the poverty profile of Pakistan over last decades. Section 2.3 discusses details of infrastructure by using Pakistan Mouza Statistics 2008.

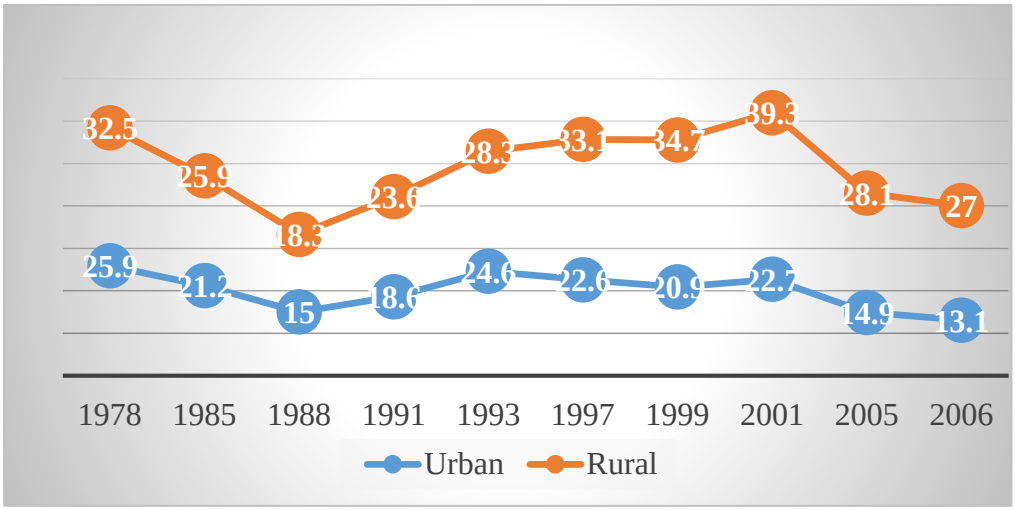
2.2 Poverty Profile of Pakistan

After 1960's, the economy was growing at good rate but the scope of this high growth rate of economy was limited to few sectors only. Because this period witnessed, the overall poverty level to be rising, more percentage of the population become victim of poverty. The country's statistics shows that the overall poverty had shown a positive trend, specifically the rural poverty has grown significantly during this period. On the other hand urban poverty has decreased over this period. According to Arif and Ahmad (2001), the main driving forces behind low poverty in urban areas were, the high growth rates of urban manufacturing units. The high growth rates of the Manufacturing sector has brought down, the poverty in the urban areas of country. On the contrary, all the pro-poor policies of government (1959 Land Reforms Act, Subsidized fertilizer, Green revolution of mid 60's and later development of Mangla Dam) have proved to be unsuccessful during this time period. The other reasons provided by the author are as follows: the TOT[1] remained inclined towards the industrial sector, widening income inequalities had been witnessed because the major beneficiaries of technology growth were the big industrialist. In addition to this, impact of subsidies were confined to big farmers

[1] Terms of trade

only, which lead to the expansion of non-agricultural sectors of urban areas. Which resulted to the reduction in urban poverty statistics but magnitude of the rural poverty was greater than the reduction in urban poverty, so it dominated on national level.

Figure 2.1 Population below Poverty Line in Pakistan



Source: Arif and Farooq (2012)

During the period of 1969/70 to 1979/80, we witness a declining trend in both rural and urban poverty though the growth rate of the economy remained lower but the economy has managed to get rid of poverty during this time period. After 1979/80 to 1987/88, we observe a negative relationship among growth and poverty (means growth rate was good and poverty has declined substantially). Arif and Ahmad (2001) and Irfan (2007) provided following reasons for this decline in overall poverty trends: 1972's land reforms were successful, secondly the workers remittances were good in 1970's and thirdly the higher urban employment and wages in construction sectors has kept poverty measure down. Irfan (2007) draws our attention towards an important point, he reports that the decline in the poverty in early 1970's was associated with massive borrowing, public sector expenditures and public sector employment.

These all factors have contributed significantly towards poverty alleviation in this era. But we were heavily indebted, which represents a situation of intergenerational poverty shift.

The policies followed in 1970's and 1980's put us into debt trap and this situation was further aggravated by reduction in foreign aid and due to Pressler's Amendment. Which forced us to stop perusing these policies which were followed in early mid 1980's. We have to divert the current and developmental expenditures to debt servicing, which lead to turn around in poverty statistics and poverty started mounting again in early 1990's. All these facts have gave rise to post 1987/88 phase of low growth and higher poverty (Irfan 2007). In post 1987/88 period, unfortunately we were not able to sustain the declining trends in poverty, poverty statistics took a U-turn and started mounting up again. This surging poverty trends are due to persistent low growth rates, socioeconomic and political de-stability. Literature (Arif and Ahmad 2001, Amjad and Kemal 1997, Irfan 2007) later confirmed that the poverty hit back Pakistan in 1990's.

Table 2.1 Incidence of Poverty across Pakistan

UNIT	**OVERALL**			**URBAN**			**RURAL**		
YEARS	1998 - 1999	2000 - 2001	2004 - 2005	1998 - 1999	2000 - 2001	2004 - 2005	1998 - 1999	2000 - 2001	2004 - 2005
PAKISTAN	30.6	34.5	23.9	20.9	22.6	14.9	34.7	39.2	28.1
PUNJAB	29.8	30.7	29.5	23.7	23.01	21.2	32.2	33.8	33.4
SINDH	26.2	37.5	22.4	15.3	20.7	13.8	34.5	48.3	28.9
KPK	40.8	42.3	39.3	26.1	30.03	26.1	43.3	44.4	41.9
BALUCHISTAN	22.1	37.2	32.9	25.2	27.4	21.5	21.6	39.3	35.8

Source: Arif and Farooq (2011)

Table 2.1 clearly presents Pakistan's poverty profile, during the period 1998-99 to 2004-05. In Pakistan, overall poverty had increased from 1998-99 to 2000-01 and declined thereafter. This rise in poverty can be associated with political unrest and international sanctions, which has significantly reduced the availability of resources for resource starved economy of Pakistan. Provincial level statistics indicates that KPK was leading other provinces in poverty incidence. However, Sindh and Baluchistan proved to be least poor provinces of Pakistan. During this period we can observe high level of inter-provinces and intera-provincial disparity.

This phase of low growth rate of the economy has ended in 2003. Inflow of funds in shape of foreign aid and workers remittances has improved during this period due to geo-political position of Pakistan. Which has facilitated the Government to again follow the aggressive policies of public expenditures and it helped the Government to get rid of evils of Poverty. Arif and Farooq (2011) had mentioned following reasons for declining poverty during 1st decade of twentieth century: high economic growth of the period of 2000-06, increased public spending on education, health and infrastructure (rural roads, electrification and better irrigational facilities), better foreign remittances, aid and rescheduling of foreign loans have contributed significantly towards poverty reduction. According to Pakistan economic survey 2013-14, increased allocation of funds to the social safety nets programs like Benazir Income Support program, Pakistan Poverty Alleviation Fund (PPAF), better support prices for agricultural produce, higher foreign remittances and higher female labor force participation are the factors which have actively reduced poverty in first decade of 21st century.

Irfan (2007) has presented an intriguing fact from history of poverty of Pakistan, that poverty had been less in the time when we had access to massive funds from abroad (1980's, 2000 and 2006). Furthermore, the inflow of higher foreign aid had been witnessed to be higher

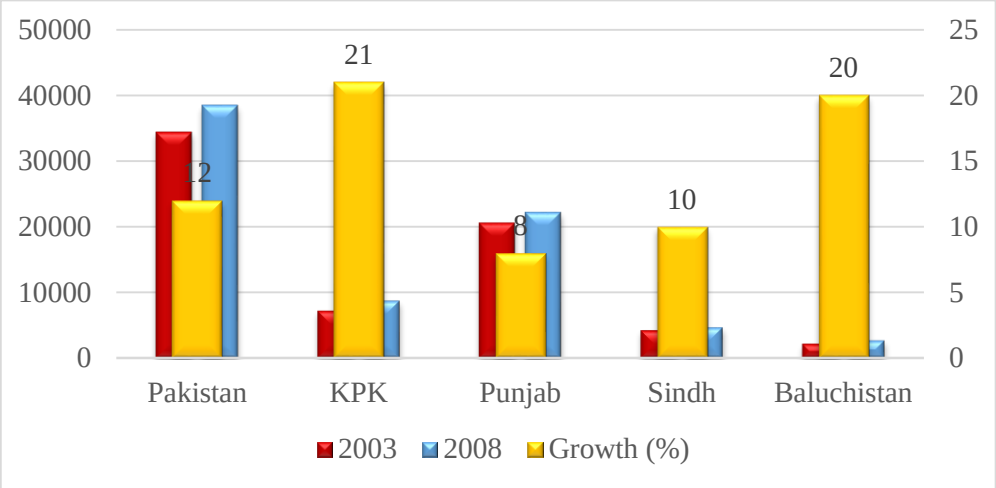
in non-democratic tenures. So he concludes that, whatever the reduction in poverty was achieved was not indigenous (which results as due to real growth of economy's production capacity in distribution and resources management), so that reduction in poverty was somehow non-indigenous. So, if we ignore the foreign hand behind the high growth of 1960's (cold war), 1980's (Afghan war) and 9/11 the story of indigenous poverty profile will be incomplete.

2.3 Infrastructure Trends

A country's infrastructure plays an important role in its economic growth, it determines the growth potential of the economy. Faster development of infrastructure is a necessary condition for the fast growing economies. Here in this study we would only be considering the rural infrastructure development. So herein after the term infrastructure means rural infrastructure. In this part of this study, we have focused on infrastructure facilities available in Pakistan at provincial level (as reported in Mouza Statistics 2008). The periodical growth of the infrastructure would be discussed later in this study in the part of descriptive statistics.

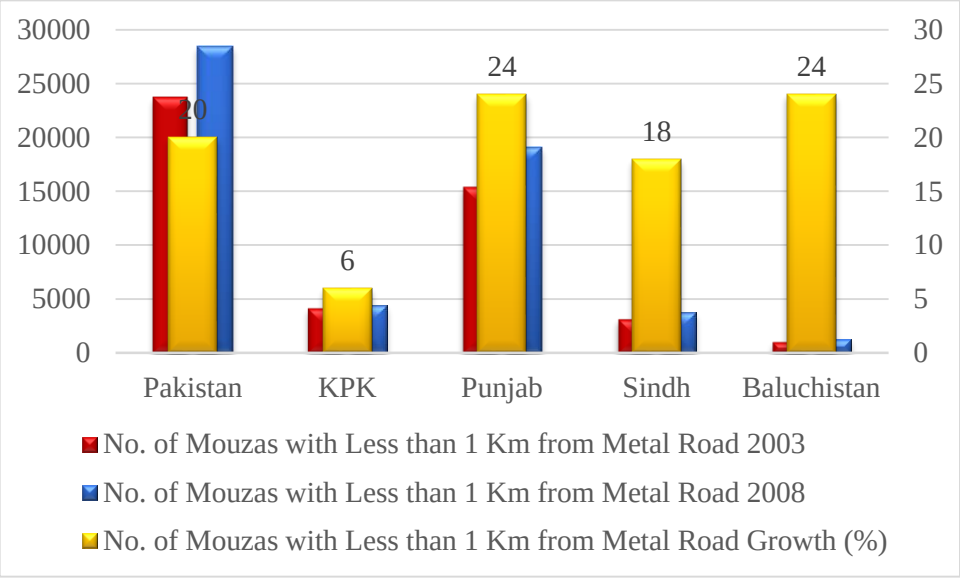
In Pakistan, rural electrification increased from 34446 Mouzas in 2003 to 38435 in 2008, thus recording growth of 12%. Province wise growth during the period 2003 to 2008 had been 21%, 8% 10% and 20% for KPK, Punjab, Sindh and Baluchistan respectively. We can observe that KPK and Baluchistan took lead in electrification of Mouzas. Further, details are given in the figure 2.2 presented below.

Figure 2.2 Electrified Mouzas



The Government of Pakistan has been consistently working on upgrading the existing highways and roads network throughout country. Because 96% of cargo handling is made through roads and highway, which gives it of immense importance that the road networks should be updated at consistent basis. New initiatives for improvement of metal roads network during 2003 to 2008 has resulted in availability of higher density of metal roads in proportion to un-paved roads. The percentage growth rate of metaled roads during the period 2003-08 had been 20% at national level. While for the provinces it has been 6% in KPK, 24% in Punjab, 18% in Sindh and 24% in Baluchistan. Details could be found in figure 2.3 given below.

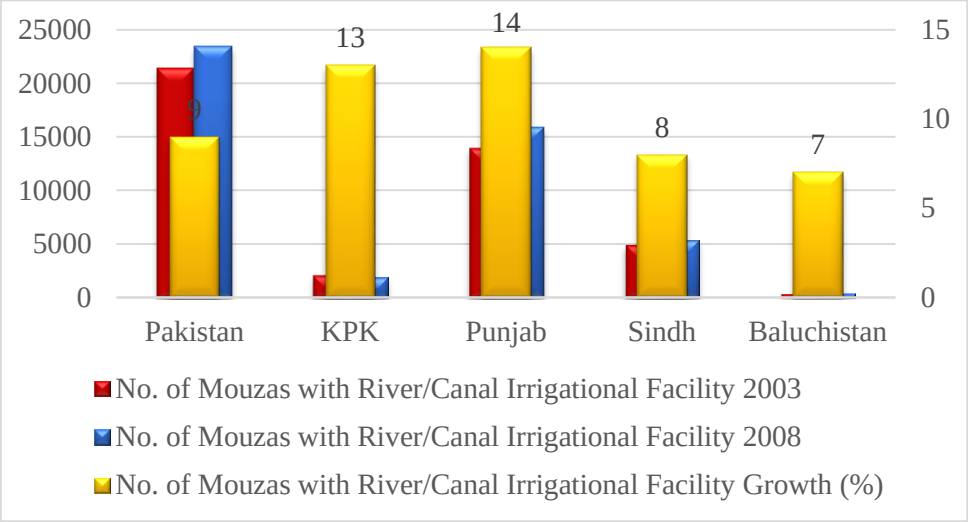
Figure 2.3 Mouzas with Metal Roads



An important benchmark is the vicinity of metaled roads from the agricultural and industrial production units. As shown by above figure. The no. of Mouzas those are connected with metaled roads in vicinity of less than 1 KM have increased from 23720 to 28760 in this time period, showing an increase of 20%. Province wise percentage growth showed that Punjab and Baluchistan took lead over other provinces. Growth rate of metaled roads network statistics has shown remarkable improvement, both at provincial and national level.

Agriculture sector contributes around 21% of Pakistan's GDP and it provides employment to 43.7% of the labor force, therefore Pakistan can be termed as an agricultural based economy. Therefore irrigational infrastructure is the backbone of agricultural sector and resultantly of Pakistani economy. According to Mouza census 2008, there has been recorded growth of canal/river connected no. of Mouzas from 21421 to 23450 showing a growth of 9% at national level. Provincial level growth rates had shown a mixed trend. Where Punjab and Sindh registered positive growth, whereas KPK and Baluchistan showed a decline in no. of Mouzas connected with canal/river irrigational facilities. Following figure 2.4 shows detailed statistics.

Figure 2.4 Mouzas with River/Canal Irrigational Facility



2.5 Schooling Index

Literature is evident of the fact that education facilities play a significant role in improving the wellbeing of people through availability of better human capital. Keeping in view the significance of this fact, we try to capture the access of rural inhabitants towards education facilities. We have constructed a schooling index, it is based on the rule of assigning equal weights to primary, middle, high schools and college facilities for both boys and girls. Which clearly presents the country level scenario. The figure 2.5 and 2.6 contains details of this schooling index. Which reveals that, at national level boys education facilities have grown at the rate of 8% during 2003 and 2008. The maximum growth in schooling index were recorded in KPK. The minimum position regarding growth of access to boy's education facilities is acquired by Sindh, where it was 5.23%. Furthermore the growth of girl's education facility was around 15% in Pakistan. During this period maximum growth in girls education facilities were achieved by Baluchistan, where it was almost 58%. Punjab recorded least growth of 8.25% during same period.

Figure 2.5 Boys Schooling Facilities

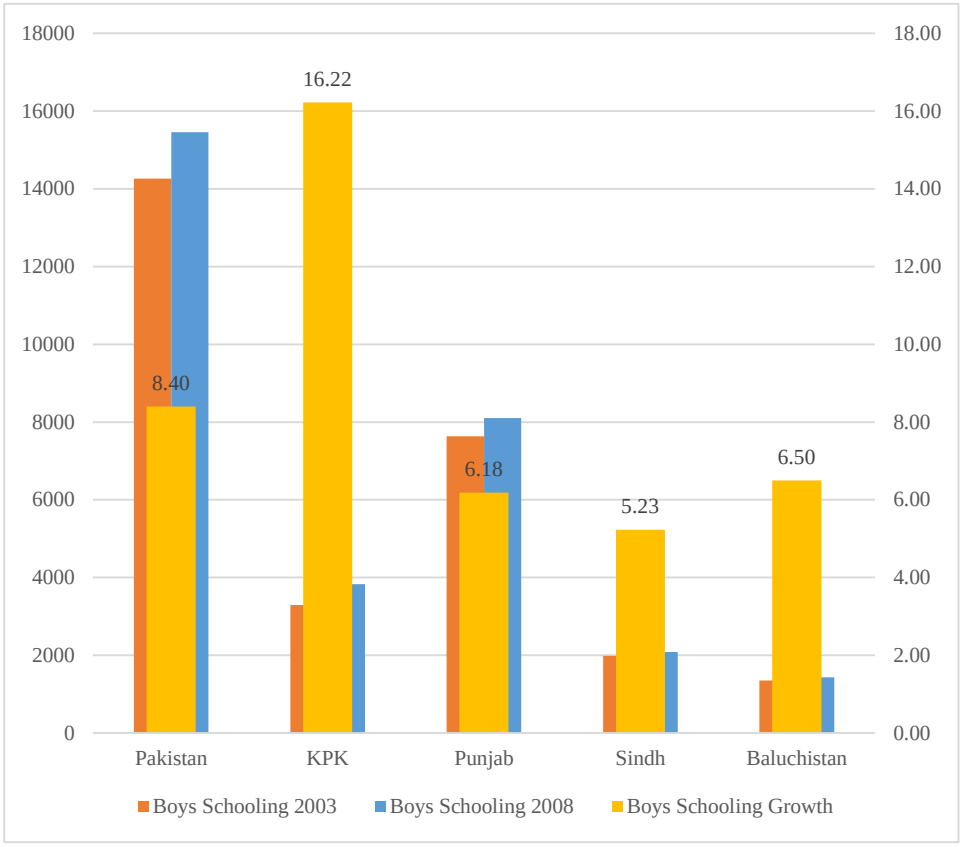
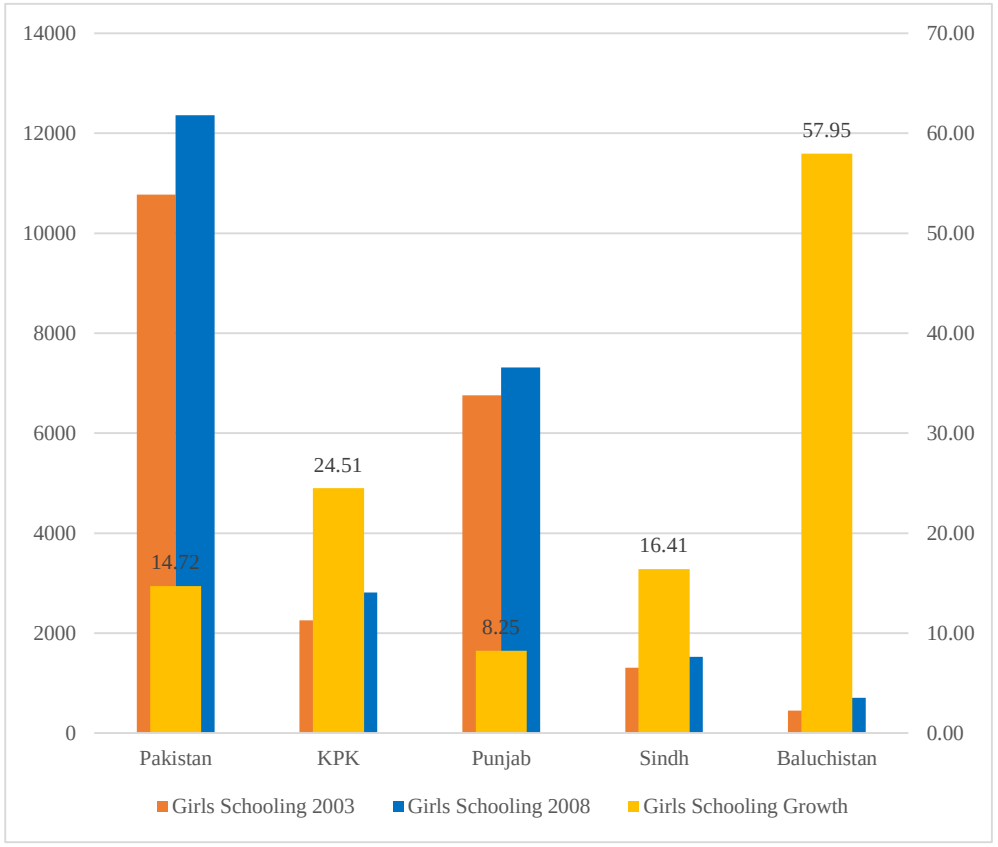


Figure 2.6 Girls Schooling Facilities



CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

The literature linking rural infrastructure and poverty is quite scanty in Pakistan. Fortunately, we have reasonable evidence from other developing countries where some researcher have done some studies on this issue. Before we proceed to our study, it is important to have a look on existing literature. In this section of literature review, we have presented those studies which were reviewed for understanding the links between rural infrastructure and poverty. National and international level studies, which comes under the umbrella of rural infrastructure poverty nexus and poverty profile of Pakistan are main part of our discussion in this section. In section, 3.1 we have discussed the international studies which have linked infrastructure development with poverty. Section 3.2 we have explored the country level studies on this issue. Section 3.3 concludes this chapter, furthermore we have tried to present, the studied literature in chronological order.

3.2 Empirical Studies on Role of Infrastructure

Wanmali and Islam (1995) have probed into the issue of rural services and drawn its implications for rural development of India. They have used cross-sectional data over two periods for different states of India and used Christaller's central place theory for comparative analysis. Findings of the study suggests that government has played its active role during these initial stages of development, which complemented the private investment. Further results indicates that across the regions there has been significant improvement in provision of rural services, Andhra Pradesh and Tamil Nadu have reaped the benefits of new agriculture

technologies for stimulating its journey of development. Furthermore, Industrial development in Maharashtra has changed the fate of this metropolitan city.

Fan *et. al.* (2000) had studied the determents of poverty in India and determined the extent of role of government investment in poverty reduction by using the pooled cross-state, time series data for 14 states of India from 1970 to 1993. The study has used the simultaneous equation model for estimating the results. The core finding of the study is that the government programs for improving the productivity (e.g. agriculture research and development (R. D), irrigation and rural infrastructural investments in electricity and roads) has contributed towards rural poverty reduction. Further, the additional investment in research and development and education has the most significant impact on rural poverty reduction and agricultural productivity. On the other hand, additional investment in irrigation and health has the least impact towards growth in agriculture productivity and poverty alleviation.

Ali and Pernia (2003) had done a review of studies, for investigating potential of the infrastructure development towards reducing poverty. This is basically review of the existing studies which suggest that rural infrastructure can lead higher direct and indirect impacts towards reducing poverty. Government investment in rural areas are critical because of two reasons, first reason is that there is higher levels of untapped potential areas (which could increase productivity easily) and second obvious reason is that majority of poor are living there. Reviewed literature confirms that road investment appears to have stronger direct and indirect effects on poverty reduction when it is combined with complementary investment (such as schooling). Furthermore, Irrigation and electricity both had the potential of reducing poverty by both direct & indirect channels.

Fan *et. al.* (2004) had tried to measure the impact of public investment on poverty reduction in rural Thailand. The study has used the pooled time series and cross-sectional data

for different variables from 1977-2000.The study has used the full information maximum likelihood (FIML) estimation technique for estimation which shows that government expenditures on agricultural research and development reduces poverty and public expenditures on electrification of rural areas, rural roads and education reduces poverty the most and improves agriculture productivity. Furthermore, public expenditures on irrigational facilities has smallest impacts on rural poverty reduction and on labor productivity in agriculture.

Kwon (2005), had scrutinized infrastructure poverty interlinkages for Indonesia by using the Panel data form 1976-1996. Instrumental variable estimates suggest that roads have significant role in poverty alleviation, it has both direct (creation of new jobs) and indirect effects (it had improved performance of other variables too and increased the linkages among markets) on poverty. Furthermore he suggests that structural model should consider role of roads separately in good and bad access to roads areas and allow the interaction of variables over time.

Warr (2005) had monitored the role of rural roads development in poverty reduction in Lao PDR. This study has used rural house hold information from the Lao (Expenditure and Consumption Survey LECS 2 covering 1997–98 & LECS 3 covering 2002–03) for its estimation purposes. Multiple regression analysis suggest that linkages of the road and poverty, a 13% decline in rural poverty is caused due to this improved access to the roads alone. Further, the study points out that 31.6% of the all the rural HH have no access to roads at all, by providing them access to roads in dry season the poverty incidence can be reduced from 33% to 29.7%. These figures can be further improved to 26%, if they are provided with all season's access to roads. Finally, study concludes that in country like Lao PDR, the roads are primitive infrastructure and improved access to roads can reduce poverty effectively.

Fan *et. al.* (2005) had tried to analyze how strategies regarding public expenditures can be changed in order to reduce poverty. This study has basically used the data from household budget survey (2000-01) for Tanzania. The Probit model estimates suggests that public investment funds should be used efficiently in order to pursue the goals of economic growth and poverty reduction. The impact of new investment in rural education and roads are strong and statistically significant and it helps in increasing per-capita income and poverty reduction in all regions. Investment in agriculture research has a large impact on poverty reduction and have a largest impact on the incomes of people associated to agriculture. Furthermore, investment in rural roads and agriculture research has different impacts across regions. Which should be kept in mind while devising strategies regarding public expenditures.

Khandker *et. al.* (2006) had discussed the income-consumption benefits of road investment by controlling heterogeneity among provinces. The study uses the BIDS panel data for estimation proposes. The fixed effect results of the study shows that investment in roads have significant impacts on poverty. The rural roads investment has substantially reduced the transport expenses and this improvement have led to a significant positive impact on men's agricultural wage. Road improvement has caused reduction in input prices (fertilizer, seeds etc.) and it had further improved the agricultural production and raised the product prices. Finally he reports that roads have substantial effect on adult labor supply and schooling of both boys and girls.

Anderson *et al.* (2006) have summarized the linkages between public investment, growth and poverty reduction with the aim of providing an overview of existing theories. This study is basically based on different theories developed over the period of time and complimented by the empirical evidences. Their finding suggest that public investment can impact economic growth and poverty through macro and micro level. At Macro level there are five basic channels through which public investment can impact economic growth and poverty

by complementing private stock of capital, by inducing higher/increased private investment, by increased coordination among different markets, by boosting aggregate demand, by increasing saving at nation's level. Furthermore, public investment can impact economic growth and poverty at micro level by quantity effect (public investment induces, increase in quantity and quality of no. of public goods and services available to both firms and the households) and price effect (this price effect may occur due to two basic reasons, publically provided goods might be substitute or complements to privately produced goods or services, secondly, they might be not pure public good and simply increase the production of a private good).

Riley and Bathiche (2006) had explored, how transport infrastructure helps in poverty alleviation in context of area with temporary unrest (Timor-Leste).This study demonstrates that such kind of study can only be conducted if field work in these conflicted areas are not disturbed due to this conflict. This study shows that the stakeholders should be considered in planning such strategies and suggests that there should be useful institutional reforms, such measures would increase the benefits of the projects. There should be a proper monitoring system for tracking the benefits of such projects (in conflicted areas). Furthermore, professional way of dealing with the issues requires resolving of data availability issues. Professionals should enhance the negotiation process with aid agencies and development lenders.

Seethanah *et. al.* (2009) had investigated, the role of transport infrastructure towards poverty alleviation. This study has used data from 20 developing countries over the period of 1985-2005.The static and dynamic GMM estimates has been adopted for estimations. Static panel test supports the existence of the theoretical links between the infrastructure and Poverty alleviation. Furthermore, dynamic GMM technique confirms the existence of the above stated link. Secondly, the causality test shows that infrastructure helps in poverty alleviation. In

addition to this, causality test confirms the presence of reverse causality (running from poverty to infrastructure as well).

Ramessur *et. al.* (2010) had investigated that how poverty respond to roads development by using panel data of 15 Sub-Saharan countries which spans over the period of 1980-2000.This study has used panel estimation techniques, results obtained from cross-section regressions (from different models) shown that the length of paved roads are negatively associated with poverty. Fixed Effect estimates shown that the length of paved roads helps in poverty reduction (because roads improves the connectivity, improves access towards new production facilities and opens new set of opportunities). Furthermore, telecommunication infrastructure and higher literacy rate helps in reducing urban poverty. Results from GMM estimation confirms the importance of infrastructure in reducing poverty.

Khandker and Koolwal (2010) had investigated that either growth in rural infrastructure and credit expansion has some role in rising per capita income and consumption of rural poor's. This study has used the panel of three different rural H.H surveys data sets.The fixed-effects estimates for per capita income shows that, electrification of the villages has increased the per capita income, commercial banks also have benefited households, and access to paved roads has also increased total per capita income of HH. Irrigation on the other hand has non-significant effect on farm income but have somehow positive effect on non-form income at initial stages. However, this increased per capita income has not translated into predicted reductions in consumption-based moderate poverty for the poorest. The credit facility in village has positive impact on both farm and non-farm income. In addition to this, per capita expenditure has also responded positively over the period to electrification, paved roads and MFIs.

Ogun (2010) analyzed the role of infrastructure (physical and social) development in reducing poverty in Nigeria. The study has used quarterly time series data from 1971:1-2005:4

and SVAR estimation technique. The results of the study suggests a negative correlation among infrastructural development and poverty. He reports that investment in social infrastructure (investment in education and health) reduces poverty significantly, as compared to physical infrastructure. Furthermore, the study recommends the strong legal frameworks, in order to reduce the level of corruption.

Sahoo *et. al.* had probed into the role of Infrastructure development in economic growth of China by using the time series data from 1975 to 2007. The ARDL and GMM results of the study suggests methodologies are being applied. The coefficients obtained by ARDL approach shows that private investment, public investment, expenditure on health and education are positively and significantly correlated with the GDP. Coefficients obtained by ARDL approach shows that infrastructure also shows positive correlation with the GDP. The elasticity of expenditure on health and education is greater than infrastructure index, however the elasticity of IF index is greater than total private and public investment Coefficients of variable by GMM methodology confirms the results for Infrastructure and for other variables too.

Dinkelman (2011) examined that how employment responds to the electrification of rural households. This study has used panel data set, fixed effect and instrumental variable techniques are used for conducting the empirical analysis. Findings of the study suggests that new access to electricity increases the employment, when electricity is used for lighting and cooking it reduces the wood fuel and increases the female employment. HH level survey points out that there is increase in the employment of both male and female, but results for increase in employment for males are insignificant. The study finds that electrification does not lead to any spark increase in demand for labor, male earning rises and female wage falls but there is no significant increase in male wages. Finally the study finds that migration potentially confounds labor market effect.

Straub (2011), had done a survey to study the available macro-economic literature that linked infrastructure and development. Author of the study finds, that researchers often fails to lay down clear research questions to be answered and it has been found that sometimes the main factor which explains the answers to the research questioned are often ignored. Furthermore, the effects of legal frameworks, differences in market structures and different institutional mechanism have not been properly considered. Finally, the challenges of endogeneity have been not properly addressed (which could be over-come by using fixed effect or instrumental variable techniques).

Majumder (2012) strived to trace the multidimensional linkages among infrastructure and poverty at regional level setups in India. Author used district level panel data and done multivariate estimations for the study. He suggests that the presence of infrastructure facility at regional level have positive impacts on income distribution and improves the living standard of the people. Dynamic relationship shows positive correlation among growth of infrastructure, consumption growth and poverty alleviation. Astonishing finding of the study is that the growth of infrastructure give rise to increased inequality across the regions because its impact on the population is not uniform. On the other hand social infrastructure (education and health) have helped in reducing poverty and inequality across the regions.

Ranamagar (2013) explored the positive impacts of basic infrastructure facilities on poverty in Bidur Nepal. The author has done small survey of 66 household for Bidur and applied multiple regression techniques for empirical analysis. Author reports that, in this community people attached to farming are financially poor. Further the distance from paved roads are negatively associated with income. Access to electricity also shows negative correlation with HH income. Further, access to drainage is positively correlated with income. Vocational training and experience gained also affects poverty negatively in the community. Working on non-agriculture sector is positively associated with HH income.

3.2 Empirical Evidence from Pakistan

Arif and Ahmad (2001) had reviewed, the existing studies and investigated how incidence of poverty has changed across agro-ecological zones of Pakistan. The results of the study shows that poverty, which has decreased in 1980s has started mounting in 1990s. In addition to this, the author reported that urban rural poverty gap had expansion during the period. Findings of the study further shows that about one third of the population is living in severe poverty. Most of these poor people are living in rural areas of the country. This study shows that Barani Punjab is least poor because of better opportunities and synchronization with urban areas. On the other hand Baluchistan is the poor province of Pakistan, due to its hard weather conditions, which boosts the impacts of droughts and other natural calamities. Feudal system in irrigated areas of Southern Punjab & Sindh helped in increasing deprivation.

Irfan (2007) basically tried to unveil the nexus between the natural resource management and poverty reduction in Pakistan. In this study author had relied on qualitative analysis (which reports the history about the poverty and natural resource management Pakistan). According to this study, poverty shown an upward trend after 1987-88, currently almost 30% of the population is living below poverty line. This study termed poverty as a rural phenomenon, and mentioned that segment of population which owns a farm are least poor than non-farm owners. Majority of the population depended on wages and income (as main source of income), on the other hand income from non-farm enterprises are second main source of income. Crop and livestock is the third main head of income. Agriculture growth has reduced poverty through direct as well as indirect channels. Pakistan can be still classified as a natural resource based economy. Because agriculture provides employment to majority of population and contributed significantly to GDP.

Siddiqui and Pant (2007) analyzed, how better transportation infrastructure financed through tax can impact the economy. This study has used computable general equilibrium model (CGS) built on social accounting matrix (SAM) foundations, and done the simulation analysis. Two types of scenarios are observed in this study, one is business as usual effect (BaU) and other is tax financed government investment in transport infrastructure. Simulation analysis shows that tax based development of transportation infrastructure has a multidimensional benefits. These type of projects has the tendency to reduce share of transportation cost in total value of commodities which positively impacts growth and exports. Further, the results of the study shows that, tax based investment in transportation infrastructure benefits in the long-run and have negative impacts in short-run. Reduced cost and externalities shows that these kind of developmental plans helps in economic growth and poverty alleviation.

Jamal (2007) done the study and provided district level income poverty estimates for Pakistan, based on combined data from two household surveys (PSLM & HIES) which were conducted in 2004-05. Findings of the study confirms the general perception that Punjab is the least poor and Baluchistan is the poorest province of Pakistan. Study finds out that the Poverty incidence is highest among cities, towns and rural areas of Baluchistan province. Furthermore, the findings of the study illustrates that inhabitants of cities and towns (which are situated at the periphery of big cities are in vulnerable condition).

Arif and Iqbal (2009) had explored the poverty and rural infrastructure nexus for different agricultural zones of Pakistan. The study had applied multivariate regression technique on data from Mouza Statistics 2003 and PSLM 2004-05. The findings of the study suggested that physical infrastructural (Metal roads, Electrification and irrigation) has significantly reduced the poverty in the rural areas of Pakistan. Secondly, social infrastructure (education both for boys and girls and health facilities) also reduced poverty in rural areas.

Multivariate analysis also confirms, that the infrastructure especially roads, electricity, provision of educations facility and public health facilities provided explanation to the differences across regions. Finally study recommended that investment in rural infrastructure should be done to curb rural poverty because poverty significantly responded to this investment.

Cheema (2010) had produced district level headcount ratio estimates. The study has obtained and linked data from two surveys, the household income and expenditure survey (HIES 2004-05) and core welfare indicators questionnaire (CWIQ 2004-05) survey conducted by FBS. Author used the Hentschel et al. (1998, 2000) mythology for combination and computational purpose. Finally, the study finds that the headcount ratio does not always shows the exact picture of poverty scenario, because it varies with the population density.

Nadeem *et. al.* (2011) had probed into the relationship between investment in infrastructure (both soft and physical) and total factor productivity in the province of Punjab. The study has used the annual time series data from 1970 to 2005. The multivariate findings of the study are as suggests that coefficient of investment in social infrastructure (rural health and education) is significant at 1% level of significance and show maximum impact at 5th lag. Further, the coefficient of physical infrastructure (investment in rural roads, electrification and irrigational facilities) are also significant and shows that 1% increase in rural physical infrastructure will improve total factor productivity (TFP) by 0.24%. Coefficient of investment in agriculture are also significant and shows that 1% increase in the public expenditures on agriculture infrastructure development would lead to increase in TFP by 0.21%. The study founds no autocorrelation and multicollinearity problems in the model.

Ahmad and Malik (2012) had strived to capture the impact of rural infrastructure development on the economic growth of Pakistan. The study has used the time series data from

period 1981 to 2010 of Pakistan. OLS estimates shows that labor force participation rate, capital stock of Pakistan, expenditure on irrigation and trade openness shows positive and significant correlation with the real GDP growth. On the other hand, expenditure on rural development, inflation and literacy rate shows negative and insignificant correlation with real GDP.

Naveed and Ali (2012) had given a methodological framework for measurement of poverty in Pakistan (at district level). Which is achieved in this study through adopting the MPI (by Alkire & Foster, 2007). The study has used the PSLM data 2008-09 in four basic dimensions: health education, living conditions and asset ownership. The study has filled the literature gap by employing MPI for district level in Pakistan and it finds that poverty is unequally distributed across districts in a province. The study reports that there is intra-provinces and inter-provinces heterogeneity in poverty in Pakistan. Furthermore, the study points out that certain poor districts belong to certain geographical area in a province and other well-off districts belong to a certain area and points out the geographical factors is main determent of poverty. The findings of the study suggest that Baluchistan is poorest province of Pakistan with almost 52% of the population living below poverty, on the other hand Punjab is least poor with 19 % of the HH living below poverty line. The study also points out that the intensity of the poverty is different across rural and urban areas.

Ahmed *et. al.* (2013), explores the macro-micro aspects of two options that either public infrastructure facilities should be financed through foreign funding (loans and grants) or we should rely on domestic production taxation. This study has used social accounting matrix for Pakistan for the year 2007-08. In addition to this, current study has utilized household budget survey for the same year. The ultimate results of the study shows that both the options (tax based financing and loans based financing) lead towards macro-economic gains and poverty alleviation in long-run and reports that public infrastructure financed through foreign

funding is comparatively a better option. In short run (first period) results for the first option (production tax based financing) put burden on industrial sector. Which results in decreased economic growth in first period. However, in long-run the real GDP grows at the rate of 1.01%, HH consumption increases by 0.94% and Poverty headcount ratio improves by 0.31%. On the other hand second option (borrowing based financing) leads to Dutch kind disease impact in first period, which leads to falling of exports. Moreover, GDP grows at the rate of 1.29%, HH consumption increases by 1.2% and Headcount ratio improves by 0.4% in long-run.

Ahmad (2013) had linked the rural infrastructure development with growth and poverty reduction by using cross sectional data of Pakistan Mouza Statistics 2008 and micro data of PSLM 2005-06. The Logit estimates of the study suggests that the rural infrastructure is not up to the mark. Further findings suggests that rural infrastructure can lead to higher economic growth in Pakistan. The study reports that primary determinants of growth and poverty reduction are household level characteristics. Furthermore, availability of uninterrupted energy especially the gas and electricity has robust effect on growth but these infrastructure facilities had secondary impacts on economic growth and poverty reduction of Pakistan.

3.3 Conclusion

The studies which have been cited above, have explored the infrastructure poverty nexus by using different methodologies across developed and developing countries of the world. Generally the literature had supported the existence of direct and indirect links between poverty and infrastructure. The literature cited classifies the infrastructure into two main branches Soft and Physical infrastructure facilities. However, a few studies have explored this issue in Pakistan's context, especially there is hardly any study which investigates this issue at district level in Pakistan. Therefore this study provides necessary incites to the infrastructure poverty issues and fills the literature gap.

CHAPTER 4

DATA AND METHODOLOGY

4.1 Introduction

This chapter explains the data and theoretical framework through which rural infrastructure impacts poverty. For achieving these two objectives, we have divided this chapter in five sub-sections: section 4.2 captures the theoretical framework and model of the study, section 4.3 describes data selection for panel generation and other bases for descriptive statistics, section 4.4 elaborates estimation technique adopted. Section 4.5 portrays the constructions of different indices used in this study. In section 4.6, we have briefly captured the descriptive statistics regarding infrastructure development.

4.2 Theoretical Framework

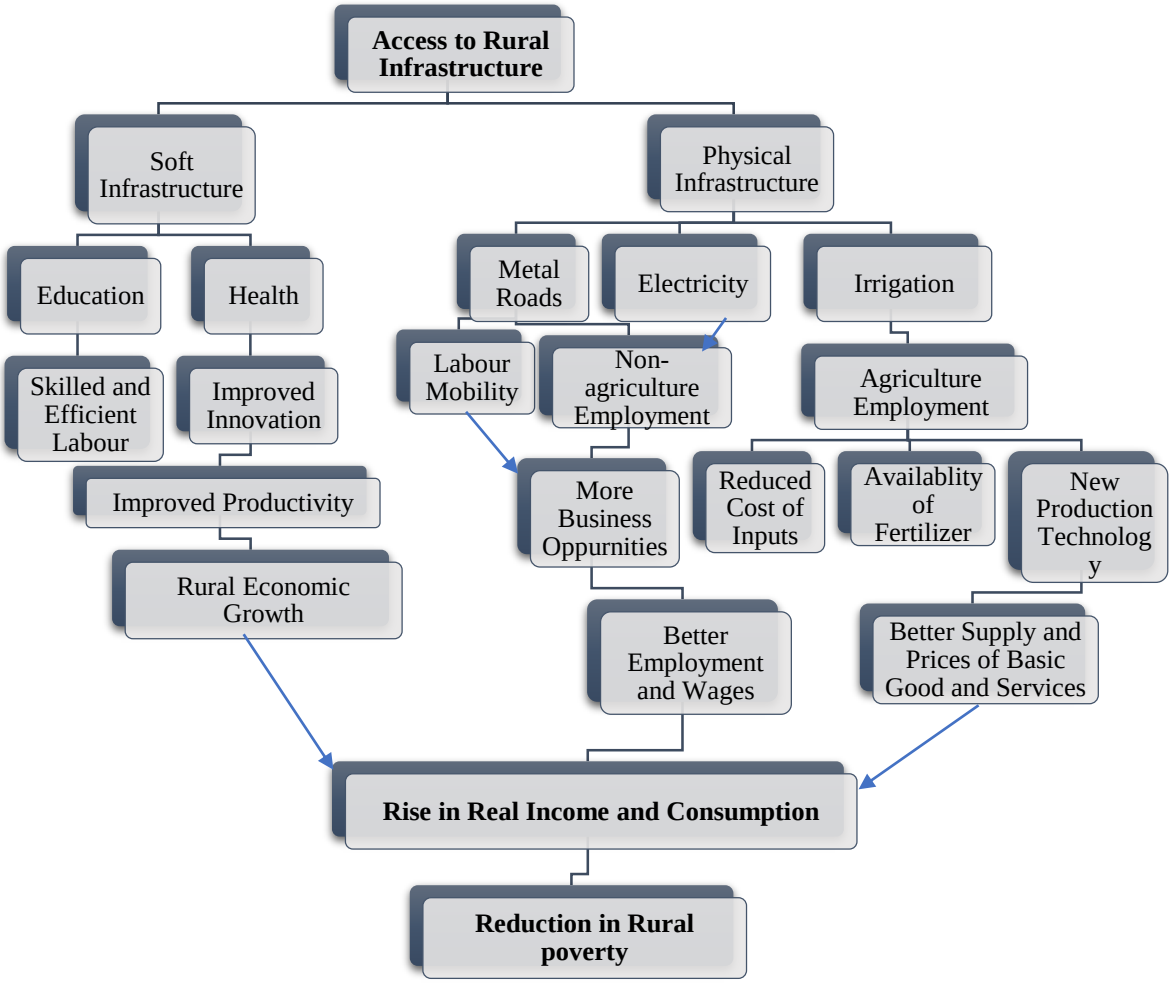
There are various arguments that supports the infrastructure poverty linkages. Earlier we have discussed that there are two types of infrastructure facilities: Soft and Physical infrastructure. These rural infrastructure facilities impacts poverty through direct as well as indirect channels. Soft infrastructure which includes educational and health facilities affects poverty through channel of better human capital. Better human capital means that productivity of the labour force will be higher which would lead to higher wages and income of people living in these rural areas. In this way soft infrastructure would lead to poverty reduction (Fan *et. al.* 2000, Ali and Pernia 2003, Fan *et. al.* 2005, Ogun 2010, Majumder 2012, Ranamagar 2013, Nadeem *et. al.* 2011).

On the other hand, physical infrastructure includes, the availability of electricity, metal roads and irrigational facilities. Physical infrastructure reduces poverty through direct and indirect channels. Basically the better physical infrastructure directly impacts poverty through

better farm and non-farm employment opportunities (Kwon 2005). In addition to this, the indirect channels through which physical infrastructure impacts poverty, are upgradation of farm and non-farm economic activities, reduction in cost of transportation, utilization of better production technologies and labour mobility. Which ultimately improves the productivity of rural economy and resultantly repays them higher levels of wages and income (Fan *et. al.* 2005, Ali and Pernia 2003, Warr 2005, Anderson *et. al.* (2006), Seethanah *et. al.* (2009) and Majumder (2012). Furthermore, better physical infrastructure especially electrification increases non-agriculture employment opportunities and facilitates new investment which ultimately leads to higher levels of employment, wages and reduction in poverty (Khandker and Koolwal 2010, Ahmad 2013).

The above theoretical discussion, suggests that the link between the infrastructure development and poverty reduction is not as simple as its looks like. But it is really important to understand the direct and indirect links between rural infrastructure and poverty, first systematic attempt to bring forth the role of public investment was done by the Keynes in 1936, when he had presented general theory of employment. After this the systematic development of literature continued over the decades, which is discussed in literature review chapter of this study. In order to capture the direct and indirect links between rural infrastructure and poverty, this study has developed the model which captures these direct and indirect links. Different studies had mentioned different channels through which infrastructure impacts poverty which are summarised in figure 4.1.

Figure 4.1 How Rural Infrastructure Affects Poverty



The figure 4.1 clearly shows, the basic mechanism through which better rural infrastructure facilities can help in poverty reduction at national level. We can classify rural infrastructure into two main branches one is physical and other one is social or soft infrastructure. Physical infrastructure mainly comprise of metal/carpeted roads, electrified areas and well established irrigational system. On the other hand soft infrastructure incorporates educational and health facilities. We can see from above figure, that better physical infrastructure facilities can promote whole economic activity through better

agriculture and non-agriculture employment opportunities and by facilitating labor mobility. Which in turn reduces the input cost, ensures availability of fertilizer and uses of new production technologies in the agriculture sector. On the other hand better non-agriculture employment opportunities improves the chances of new business. Which would ultimately lead to higher level of employment, wages & income and economic growth. Which in turn improves the real income and consumption of the rural people. On the other hand, better health and educational facilities would ensure higher level of productivity through more innovation and through skilled labor force and it would ultimately lead to reduction of poverty.

As it has already been discussed that infrastructure impacts economy through direct as well as indirect channels. Availability of these facilities increases the pace of development through various channels like labor productivity gains (resulting from improved information, reduction of time wasted in commuting to work, reduced stress, improvement in health and education etc.). On the supply side, better stock of infrastructure improves the production and employment. On demand side it fulfills the desires of people (like availability of better services, provides them clean drinking water, electricity and transportation facilities). Keeping in view the relative importance of both physical and soft infrastructure facilities we have constructed our model and incorporated the important variables like water treatment facilities (canal water irrigational facilities and piped drinking water) and role of institutions in our model (like Police Stations and Vocational training centers) in addition to other components of physical and soft infrastructure. Furthermore, the earlier studies has considered only the time series aspects of physical and soft infrastructure, on the other hand this study has captured both time series as well as cross-sectional aspects of physical and soft infrastructure. In this way this study takes the lead on other studies (like Ahmad *et. al* 2012, and Ahmad 2013) which are done earlier on the role of infrastructure development in Pakistan.

To magnify the relative importance of role of rural infrastructure facilities in poverty reduction at district level we would use panel estimation techniques in this study. This study is based on the conceptual framework developed earlier in this chapter and we have directly modelled poverty as a function of HC, CC, and FF.

$$\boldsymbol{Poverty = f\,(HC, CC, FF, Z)} \quad \textbf{..... 4.1}$$

Poverty is our dependent variable and range of other variables which are taken in the form of indices are our independent variables. Where FF denotes the percentage availability of financing facility in the Mouza, here we are using the availability of banking facility as a proxy for financing facility, HC denotes the household characteristic like what is the average size of household and what is the average age of household head in the district (which are incorporated in our model through demographic characteristics). CC denotes the community characteristics, like physical and soft infrastructure, which includes the no. of Mouzas of the district which have electrification facility, how many no. of Mouzas had piped drinking water facilities, education and health facilities. Z captures the impact of other unobserved agro-climatic effects which are not captured by other variables in the Equation.

Poverty is our dependent variable and infrastructure and other controlled variables would be used as independent variables. To model this, following econometric Equations would be used to capture the links between infrastructure and poverty reduction. By incorporating the indices, the functional form of model would look like:

$$\boldsymbol{Povit = \gamma 0 + \gamma 1\,PHYINFit + \gamma 2\,SOFTINFit + \gamma 3 Demographit +}$$

$$\boldsymbol{\gamma 4 B.FACTit + \varepsilon it} \quad \textbf{..... 4.2}$$

4.3 Data

In Pakistan the farming communities used to live in dense and scattered areas which are known as "Deh or Mouza". The record about area of mouza is properly maintained by Revenue department. Each mouza has its unique name, as well as reference number and it is the gross root level revenue estate. Rural infrastructure has strong implications on overall development especially the development of agriculture sector. Agriculture Census organization is the main organization who keeps the record of rural infrastructure data at regular intervals[2]. There are eight such censuses available for Pakistan which are published every five years, we have used the census from 1983 onward for doing descriptive analysis and latest two (2003 and 2008) for panel construction. We have not used the earlier census reports because there were major differences in information reported. This mouza census basically covers two types of facilities, one which is situated within the Mouza (like availability of electricity, drinking water, irrigational facilities) and the other which is located at some distance from the Mouza (like school, roads, health facilities etc.). This study has collected and organized the data, from the two main sources. Physical and soft infrastructure data have been taken at the district level for rural areas of Pakistan, from Pakistan *Mouza*[3] Statistics 2003-04 and 2008-09. Information regarding household characteristics which are incorporated through the demographic index in our model, are mainly drawn from the Pakistan Social and Living Standard Measurement 2004-05 and 2008-09 published by Pakistan Bureau of Statistics which covers almost 110 districts across the all provinces in Pakistan.

[2] This Mouza statistics is published every five years

[3] A *Mouza* is the lowest administrative unit in rural areas of Pakistan and commonly used for land records, revenue collection, census block and seat allocation in the local bodies. Mouza Census basically reports data for rural areas as well as partly urban areas.

In this section, we would briefly explain, the construction of the panel and calculation of Compound Annual Growth Rate (CAGR, herein after referred as growth rate, which is used for explaining the infrastructure development over decades). We have constructed a Panel of 83 districts from four provinces of Pakistan. This selection of districts were purely based on the availability of data in Mouza statistics and PSLM. CAGR generally refers to year to year percentage increase/growth of any investment over the specified time period, but in this study we have calculated it for investment in infrastructure. CAGR is the actual increase in reality because it smooths out the growth rate of investment over period of particular time. In this way it's quite helpful in explaining growth, instead of normal percentage based measures.

4.4 Estimation Technique

The panel data comprise of a sample with N cross-sections which are observed at different time periods. In general, simple linear panel data models could be estimated using three different methods: (a) with a common constant (b) allowing for fixed effects[4] and (c) allowing for random effect. The common constant method generally known as pooled OLS method of estimation presents the results under the principal assumption that there are no differences among the data matrix of the cross-sectional dimensions (N). In other words estimated model have common constant *a* for all cross-sections. However, this case is quite restrictive and normally the fixed effect or random effect are generally more inclusive.

4.4.1 Fixed Effect Method

Fixed effect model captures all those attributes which are specific for any particular cross-section (districts in our study's context) but which don't change over time like geographical factors, agro-climatic endowments, sunshine, flood potential etc. The fixed effect

[4] Due to data limitations, we were unable to estimate our model through GMM and IV techniques because we don't have sufficient data base for generating the lags terms and in this scenario Fixed effect model remained the most appropriate choice

model allows the constant to be cross-sectional specific. These un-observed cross-sectional effects are well captured by fixed effect. These unobserved/unmeasured effects which remain same over time but differs across the cross-sections are correlated with dependent variable. Fixed effect model assumes that variations across groups can be dealt with, by variations in constant terms through incorporation of dummy variables for each group. That is why this estimation technique is also known as least square dummy variable estimation technique. Each cross section's constant is treated as unidentified parameter to be estimated. Constants are districts (cross-section) specific in fixed effects method. So each districts can have a different value of constant in fixed effect model. For example consider following general model:

$$\boldsymbol{Yit = \alpha i + \beta 1\, X1it + \beta 2 X2it \ldots\ldots\ldots\ldots + \beta k\, Xkit + uit} \quad \textbf{4.3}$$

This equation can be written as in matrix form

$$\boldsymbol{Y = \alpha D + \beta' X + u} \quad \textbf{4.4}$$

Where, $Y = \begin{bmatrix} y_1 \\ y_2 \\ \cdot \\ \cdot \\ y_N \end{bmatrix}$, $D = \begin{bmatrix} i_t & 0 & 0 & . & . & 0 \\ 0 & i_t & . & . & . & 0 \\ . & . & i_t & . & . & 0 \\ . & . & 0 & i_t & . & 0 \\ . & . & 0 & . & i_t & 0 \\ 0 & 0 & 0 & 0 & 0 & i_t \end{bmatrix}$

$X = \begin{bmatrix} x_{11} & x_{12} & x_{13} & . & . & x_{1k} \\ x_{21} & x_{22} & . & . & . & x_{2k} \\ . & . & . & . & . & . \\ : & : & : & : & . & : \\ x_{N1} & x_{N2} & x_{N3} & 0 & 0 & x_{NK} \end{bmatrix}$, $\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ . \\ . \\ \alpha_N \end{bmatrix}$, $\beta' = \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ \beta_N \end{bmatrix}$

Where dummy variable is the one that allows us to take different group specific estimates for each of the constants for each different section.

4.4.2 Random Effect Method

Alternative to fixed effect model is the Random effect model. Main difference between fixed effect and random effect is that random effect model don't include constant as a fixed but includes it as a random parameter. Hence for each cross-section the variation in constant comes from the basic equation:

$$\boldsymbol{\alpha i = \alpha + vi} \ldots\ldots\ldots\ldots\ldots\ldots \textbf{4.5}$$

Where vi is a variable with mean=0.

Basic Random effect model can be written as

$$\boldsymbol{Yit = (\alpha + vi) + \beta 1\, X1it + \beta 2 X2it} \ldots\ldots\ldots\ldots + \boldsymbol{\beta k\, Xkit + uit} \ldots\ldots\ldots\ldots \textbf{4.6}$$

$$\boldsymbol{Yit = \alpha + \beta 1\, X1it + \beta 2 X2it} \ldots\ldots\ldots\ldots + \boldsymbol{\beta k\, Xkit} + (\boldsymbol{vi + uit}) \ldots\ldots\ldots\ldots\ldots\ldots \textbf{4.7}$$

Modelling individual specific terms as randomly distributed across districts are more appropriate if strictly uncorrelated individual effects are there.

4.5 Construction of Indices

This section comprises of description of physical index, soft index, demographic index and poverty index and their indicator are discussed. These indices are generated on the basis of variable obtained from the *Mouza* statistics (2003-04 and 2008-09) and Pakistan Social and Living Standard Measurement (PSLM), 2004-05 and 2008-09. Poverty indices are taken from already existing studies. Infrastructure and demographic characteristic index are used as explanatory variables to explore its effects on poverty which is our dependent variable.

Principal Component Analysis (PCA) has been used to construct all the indices except poverty index in Stata version 12. Principal Component Analysis is a simply a variable reduction procedure and it assigns weight according to the variance of the variable. This

technique reduces the number of relationship by grouping or clustering together are those variables which are highly correlated with each other into one component or factor. The first component explains the maximum amount of variation in the data and last component the minimum. The first Principal Component Analysis account for a sizeable part of the variation in the data. In all the cases the first Principal Component can explain more than the 70 percent of variation and hence only the first was taken and further analysis is based on these indices.

4.5.1 Poverty Index

We have used, the poverty index from already existing studies of Jamal (2007) and Naveed and Ali (2012). Education, health, living condition and financial assets and landholding variables are used to construct the head count ratio or poverty index at the district level. The poverty variables are measured as the percentage of people living below the poverty level i:e H=H(Y,Z) such that H=q/n where q(N,Z) is the measure of all poor individual set Z_k Household facing deprivation of 33 percent of weighted sum of dimensions are considered poor.

4.5.2 Physical Infrastructure Index

There are many indices for physical infrastructure which have been developed by the researcher. In this study, we have also constructed an index to have the value for the physical infrastructure. Physical infrastructure, in this study has been measured on the basis of four components i.e. electrification, drinking water, irrigation facility and availability of metal roads. Afzal and Pernia (2003) have used these variables to construct the physical infrastructure index except drinking water. Drinking water has been included in water treatment facilities by Ranamagar (2013) and Ahmad et. al (2013). So we have incorporated these four variables, in the construction of Physical Infrastructure.

4.5.3 Social/ Soft Infrastructure Index

We have calculated, soft infrastructure index using available information from the *Mouza* statistics (2003-04 and 2008-09) and five main variables are selected. These variables are availability of primary, middle, higher education, colleges and vocational centers for both girls and boys within one kilometer of distance. We have used the presence of education, health facility and Police stations within the radius of 1 kilometer of the mouza to construct the soft infrastructure. Khandker and Koolwal (2010) had included police stations (Thana) in the category of other local institutions in defining the determinants of social characteristics, in addition to health and education facilities.

4.5.4 Demographic Characteristic Index

We have incorporated household characteristics through demographic index in our study. These household characteristics include, Size of the household and age of household head from PSLM (2004-05 and 2008-09). Household size means the total number of members in house. In general, it is considered that household with larger family size, have a small per capita consumption. Thus we can say that there exists a positive relationship between the household size and poverty. Age of the household head means, age of the head of the household either male are female. Household head, with older age have a small per capita income. Hence we can say that there exist a negative u-shaped relationship between the poverty and age of the household.

Table 4.1 Summary of the Variables which are used to Generate Indices

1	**Soft Infrastructure Index**	Primary Education Middle Education Higher Education College Education Vocational Training Centers Civil Hospital/Rural Health Center/Dispensary Police Stations	• Education facilities incorporates the percentage of Mouzas with public and private schools/colleges and vocational training centers, both for boys and girls situated within less than one kilometer distance from the mouza. • Health facilities include the percentage of Mouzas which have anyone of health facilities situated with the radius of less than one kilometer • Police Stations means any post or Police Station Situated within the distance of less than one KM
2	**Physical Infrastructure:**	Electrification Piped Drinking Water Irrigation Metal Road	• Percentage of Mouzas of a district which have electricity wholly or partly are taken. • The availability of piped drinking water supply throughout the year in a village is considered. • Irrigation facilities refer to the percentage of Mouzas of district with wholly or partly lined/improved water courses from canal to mouza. • Metal roads means availability of metal roads in the vicinity of less than 1 KM
3	**Demographic Index**	Household Size Age of Household head	• Household size means the average size of household at district level • Household head age refers to district level average value of household head age

4.6 Descriptive Statistics

For better understanding of rural infrastructure development, we have made two subsections (rural physical and soft infrastructure). The section 4.6.1 illustrates physical infrastructure development across four provinces of Pakistan (which includes development of basic facilities like electrification of the Mouzas, development of rural roads and availability of better irrigational facilities). Section 4.6.2 covers details of region wise availability of soft infrastructure (whose major components are educational and health facilities).

4.6.1 Physical Infrastructure

Availability of electricity to rural areas, is the main tool though which we can improve the productivity of the residents of the rural areas. Baluchistan took the lead in percentage growth of Electricity facility over the period with annual growth rate 11% in 1988 and KPK was proceeding all provinces with almost 4%, during this era. According to latest data, the least growth is attributable to KPK in 2008. Where growth in electrification facility have recorded a declined at the rate of 2% (as shown in figure 4.2).

When we put a glance on the percentage availability of electricity as reported by latest available data of Mouza Statistics 2008, we come across important fact that, Baluchistan was not leading in electrification of the Mouzas. It was actually Punjab, which took lead over all other provinces with almost 93% of the Mouzas with electrification facility in 2008. On the other hand, Baluchistan had the least no. of Mouzas with electrification facilities. In Baluchistan, almost 42% of the Mouzas were having the electrification facility in this period. Further periodic details are available in figure 4.3.

On the average the growth in availability of metal road facility within the distance of less than 1 kilometer from the Mouza have shown a non-linear behavior over the period. The maximum growth was achieved by Baluchistan in 1993 with almost 9% per year growth during

the period of 1988 to 1993. On the contrary, Sindh has shown a minimum growth of 3% per year in the same period. Furthermore minimum expansion in metal road network was recorded during the period of 2003 to 2008.Where in KPK per year decrease in this facility were reported to be 10%. In this period, Punjab has achieved the maximum per year growth of 5%. Further details are illustrated in the figure 4.4.

If we observe percentage availability of metal roads, we find that in 1993 actually Punjab had greatest no. of Mouzas (almost 57%) as compared to Baluchistan, where this figure was only 16%. According to the latest Mouza Census (2008), Punjab have maintained its top position, with almost 80% of the Mouzas with metal Roads facility, on the other hand, Baluchistan was reported to be most deprived province with almost 20% of Mouzas with this metal road facility. Further details are provided in the figure 4.5.

Figure 4.2 Growth of Electrified Mouzas

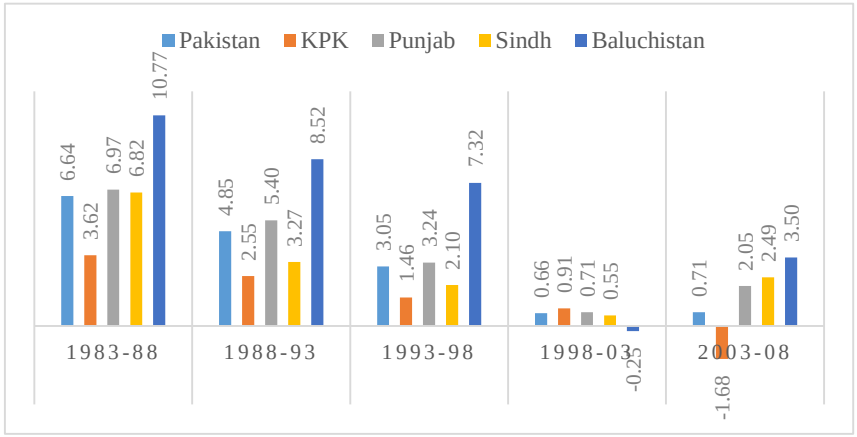


Figure 4.3 Availability of Electricity Across Provinces

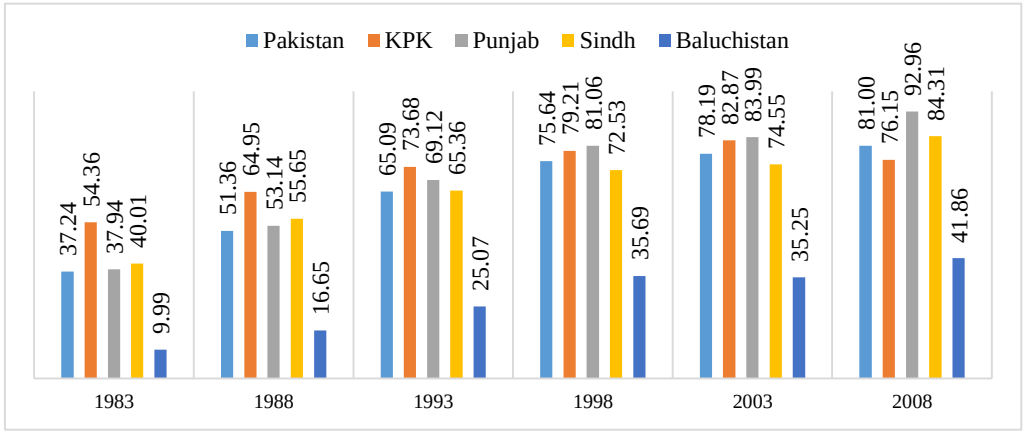


Figure 4.4 Growth of Metal Road Network

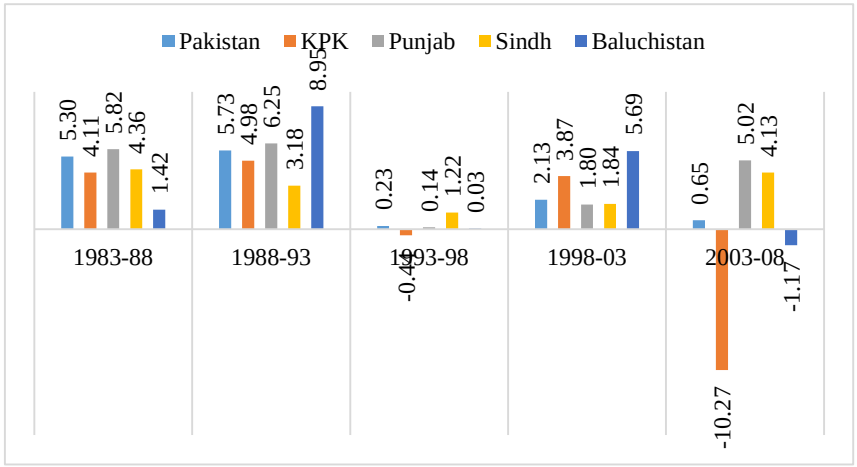
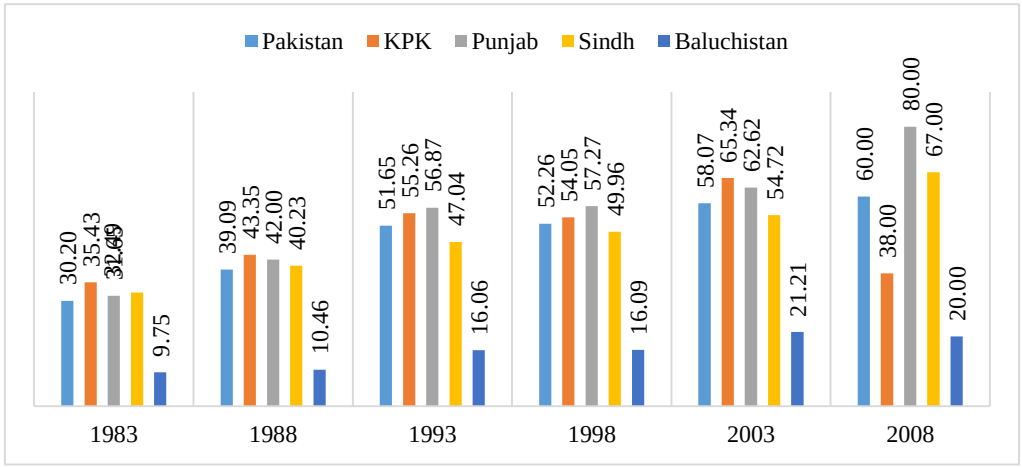
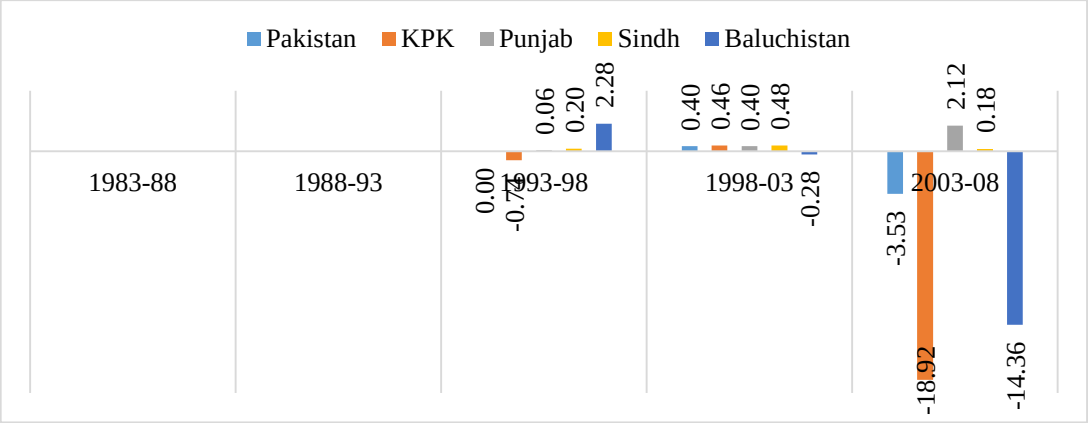


Figure 4.5 Availability of Metal Roads



Mouza Census from 1993 to 2008 reports that the Mouzas with Rivers/ Canals as a main source of irrigational facility[5] had shown mixed trends in the growth of this facility. Census data shows that Baluchistan was leading other provinces with almost 2% annual growth from 1993 to 1998. During this period minimum per year growth rate was reported to be of KPK province. Latest census of 2008 shows that Punjab had achieved maximum 2% per year growth and KPK had shown maximum per year reduction of almost 18%. Further details are available in the figure 4.6 illustrated below.

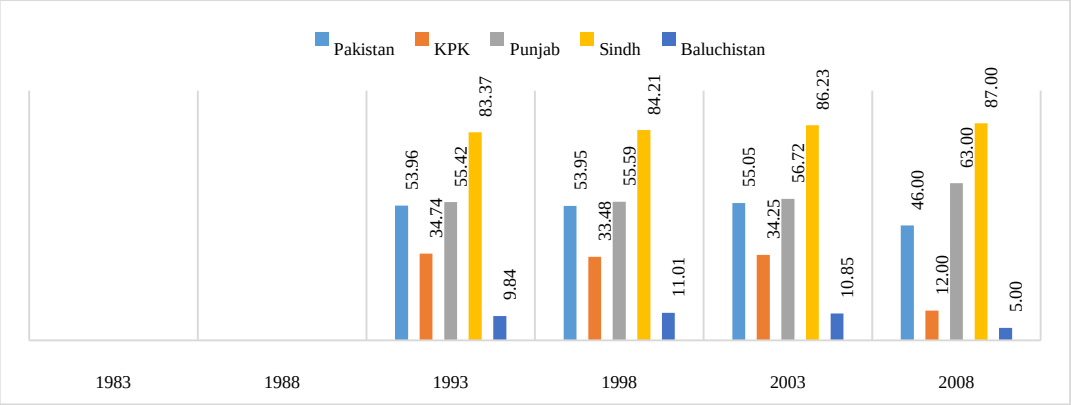
Figure 4.6 Growth of Irrigational Facility



If we look into percentagewise availability of irrigational facility, we find that Overall position was better in Sindh throughout the period of study (1993-2008). Where in 2008 almost 87% Mouzas of Sindh province were having river/canal as a main sources of irrigational facility. On the other hand, in Baluchistan province, this river/canal irrigational facility remained persistently low.

[5] Data regarding Irrigational facility was not reported in the earlier reports of 1983 and 1988.

Figure 4.7 Percentage of Irrigational Facility



4.6.2 Soft Infrastructure

Education is the integral part of soft infrastructure, as far as the primary education is concerned maximum growth in boys primary education facility situated in the vicinity of less than 1 kilometer was recorded in Baluchistan province in the period of 1983 to 1988. Where highest per year growth of almost 9% was recorded in boys primary schools facility. During the same period minimum growth was recorded in KPK where this facility had grown at 2% per annum. The latest Mouza Census shows that Sindh has taken lead in per year growth of boy's primary education facility. In Sindh this facility has grown at the rate of 2% per year, on the other hand KPK was reported to be having minimum growth in boy's primary schools. Where this facility has shown a per year decrease at the rate of 4. Further details are contained in the figure 4.8.

As far as, the girls primary education facility is concerned the Baluchistan has shown a maximum per year growth rate of 10% in 1988 to 1993. The latest report shows that Sindh has took lead over other provinces where annual growth rate was 6%, and KPK was lagging in this facility where 5% per year reduction has been observed during the period of 2003 to 2008. Details are available in the figure 4.10.

Figure 4.8 Growth of Boys Primary Schools

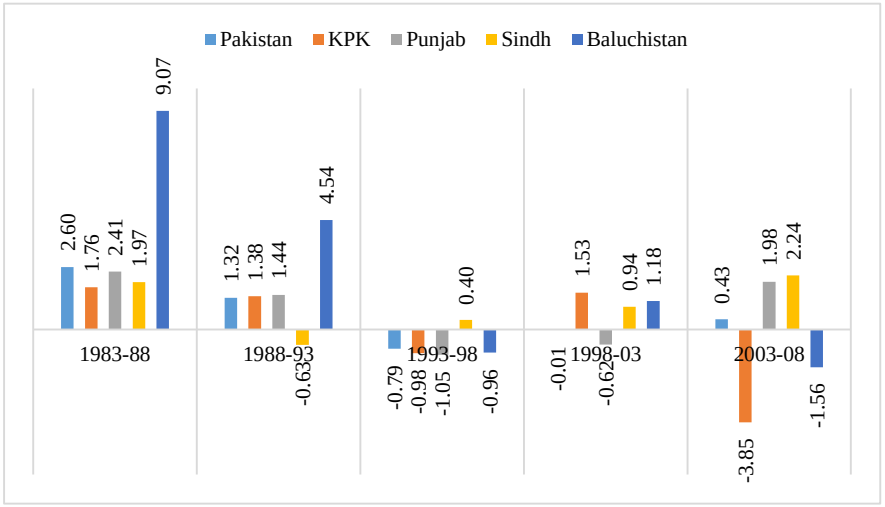


Figure 4.9 Availability of Boys Primary

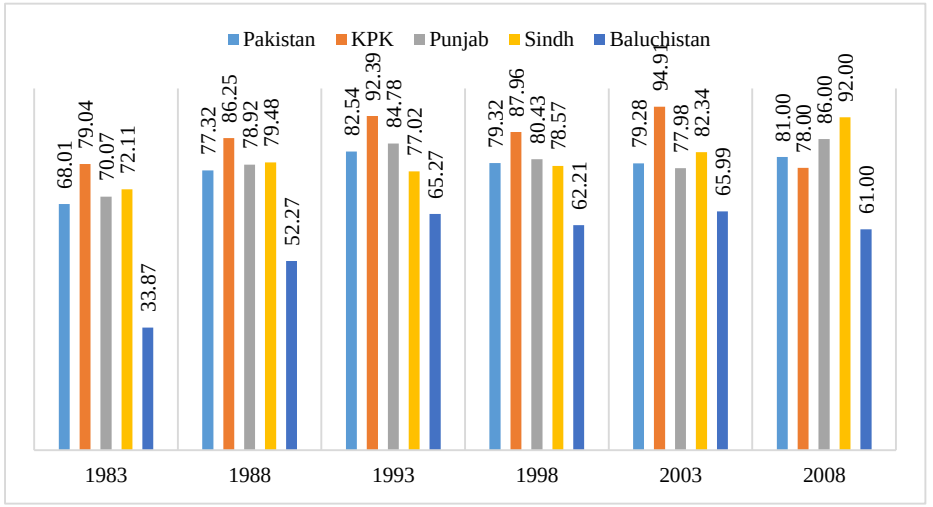


Figure 4.10 Growth of Girls Primary Schools

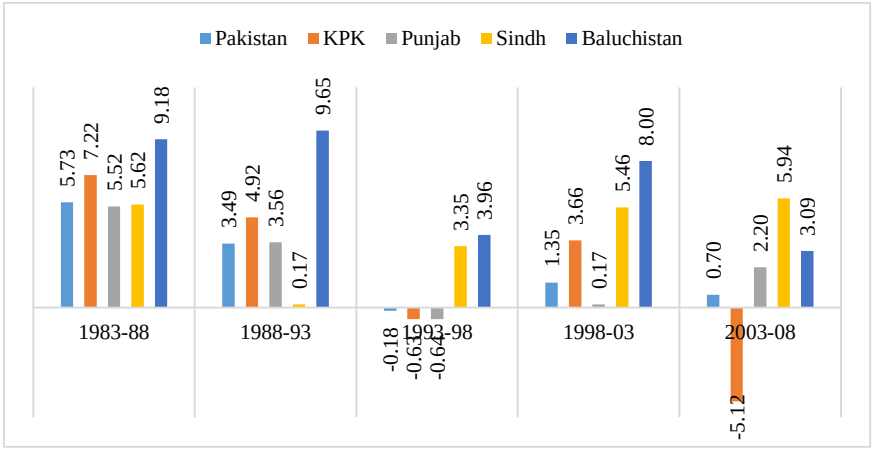
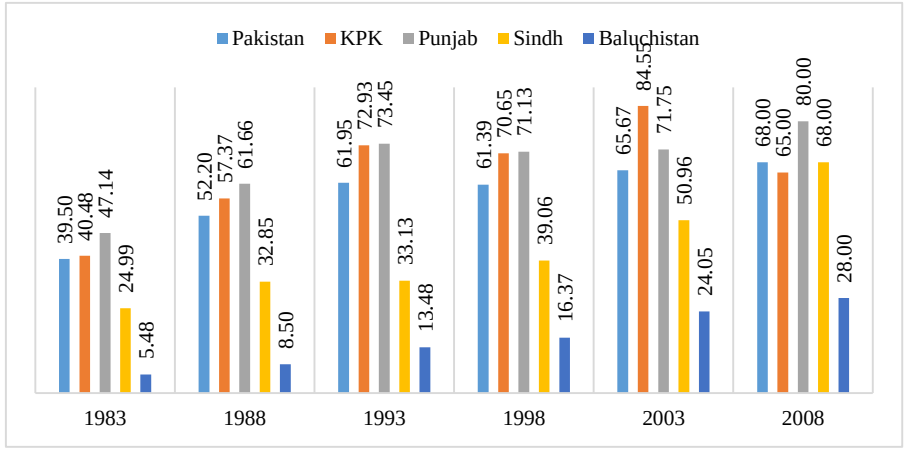


Figure 4.11 Availability of Girls Primary Schools



The boy's primary schools facility remained maximum in KPK and minimum in Baluchistan throughout the period except 2008. In KPK almost 95% of the Mouzas were having boy's primary schools facility in 2003. During same period Baluchistan was having 66% of the Mouzas with boy's primary schools (this was minimum). The latest census report shows that Sindh has lead with almost 92% of the Mouzas with this facility on the other hand only 61% Mouzas of Baluchistan had this facility. As illustrated in figure 4.9

Punjab took lead in girl's primary education over the period of the study except 2003. On the other hand Baluchistan was the most deprived province in girl's primary education facility throughout the period. The latest figures shows that Punjab had maximum 80% of the Mouzas with this girl's primary education facility and Baluchistan were having only 28% of the Mouzas with this facility (which is minimum among provinces). Details are reported in the figure 4.11.

The higher secondary/ high schools for boys, Sindh has shown maximum growth of 16% per year during the era of 1988 to 1993. Least annual growth of 7% were recorded in KPK during above cited period. Details are presented in figure 4.10. In girls high school facility, Baluchistan had took lead over other provinces, where 27% per year growth were recorded in the period of 1988 to 1993 and KPK has shown least growth in this period. Latest data from Mouza statistics shows that Punjab had took lead over other provinces with 2% per year growth rate from 2003 to 2008. Details are available in the figure 4.12.

Figure 4.12 Growth of Boys High Schools

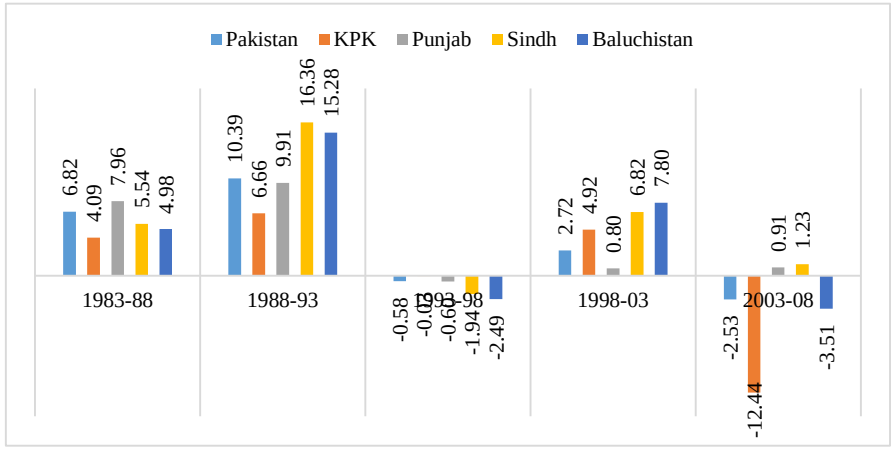
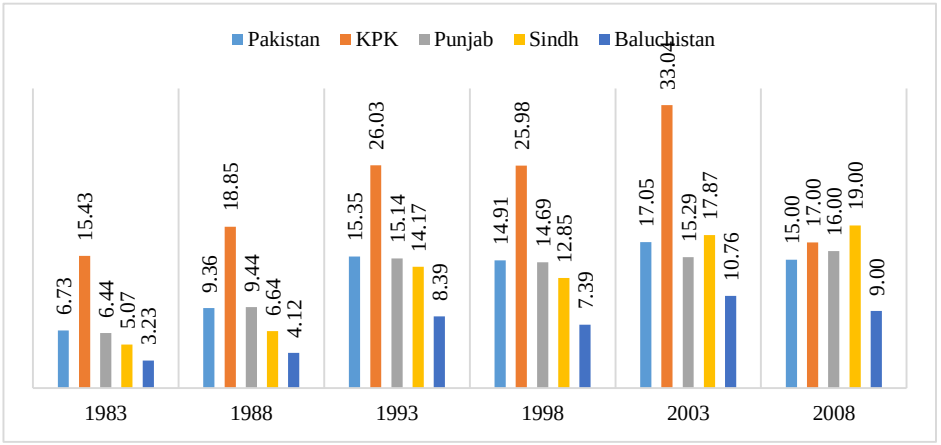


Figure 4.13 Boys High Schools



***Fi*gure 4.14 Growth of Girls High School**

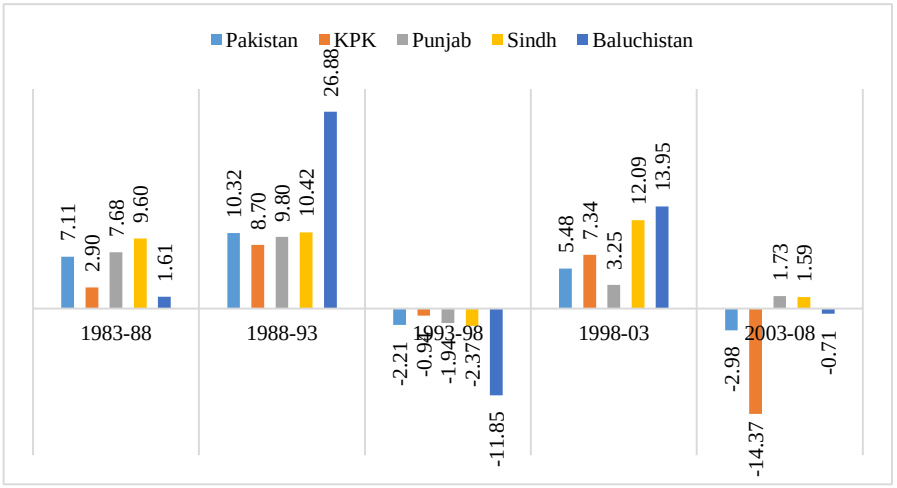
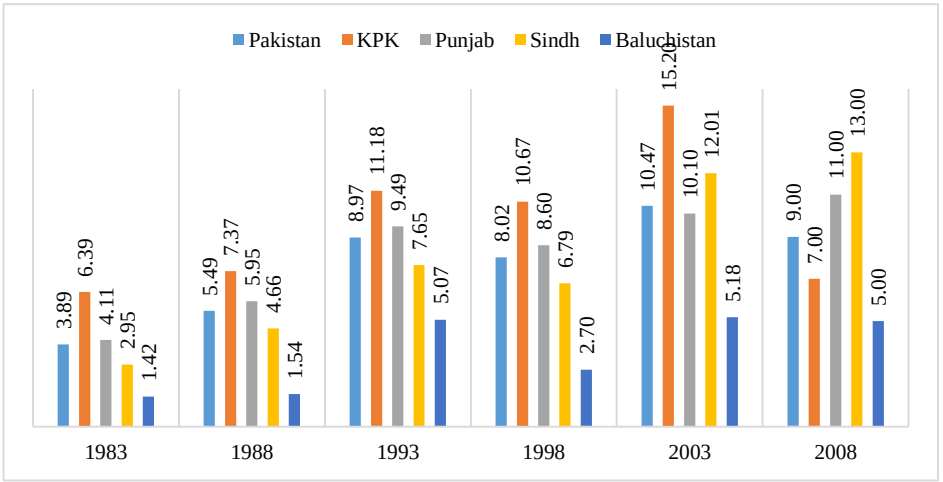


Figure 4.15 Girls High Schools



If we look on the percentage availability of the high school facility, we find that KPK was leading and Baluchistan was lagging all the provinces in boys High school facility except 2008. In KPK almost 33% and in Baluchistan almost 11% of Mouzas were having boy's high school facility in 2003. Sindh was leading in 2008 with 19% and Baluchistan was lagging with 9% Mouzas with this facility. Details can be found in figure 4.13.

On the Other hand, girl's high school facility was available at the max in KPK except 2008 where this position was competed away by Sindh where almost 13% of the Mouzas were having girl's high schools. Details are contained in the figure 4.15.

Mouzas with boys college facilities situated within the vicinity of less than 1 kilometer from the Mouza shows that maximum growth of 39% per year were achieved by Baluchistan in the period 1988 to 1993. During this period KPK showed a per year growth of almost 9% (which was lowest among provinces). Latest data shows that Punjab has took lead in per year growth rate. Further details are available in figure 5.15. Baluchistan again took lead over other provinces with almost 74% per year growth in girl's college education facility during 1988 to 1993 within same period KPK showed the least per year growth of 6%. Details are shown in figure 4.18

Percentage availability of boy's college education was highest in Sindh in 2008, where almost 7% of the Mouzas were having this facility. When we look on the percentage availability of girls college education facilities, we find that Sindh was leading in 2008 with 7% of Mouzas with girls college facilities within the distance of less than 1 KM. KPK was having least 2% of the Mouzas with this facility in 2008. Further details are incorporated in Figures 4.17 and 4.19.

Figure 4.16 Growth of Boys College

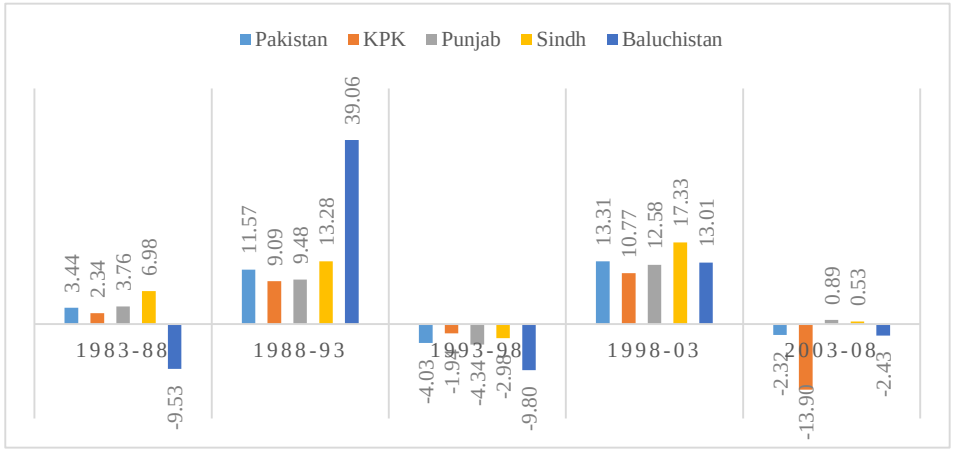


Figure 4.17 Boys College

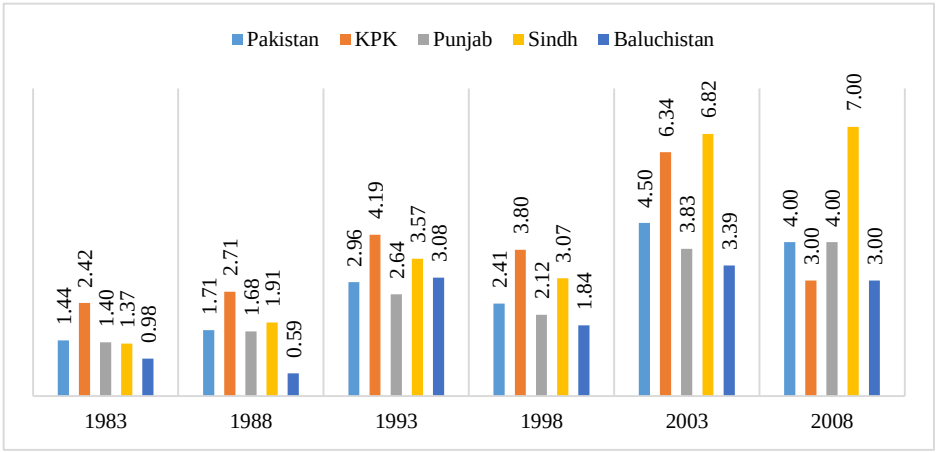


Figure 4.18 Growth of Girls College

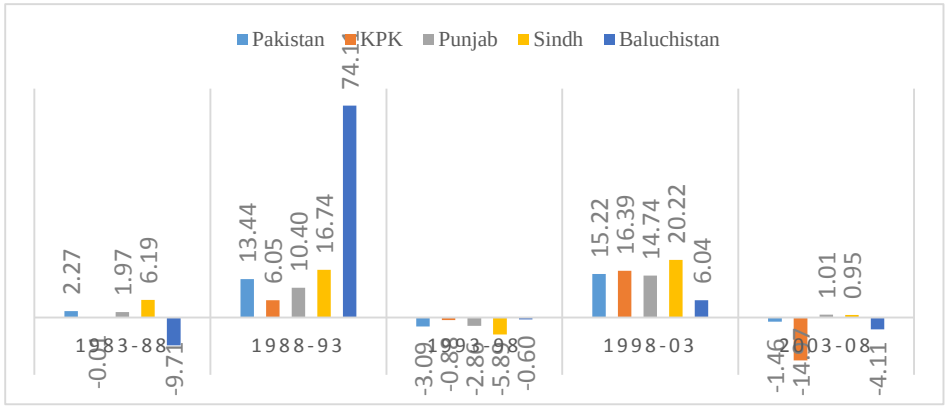
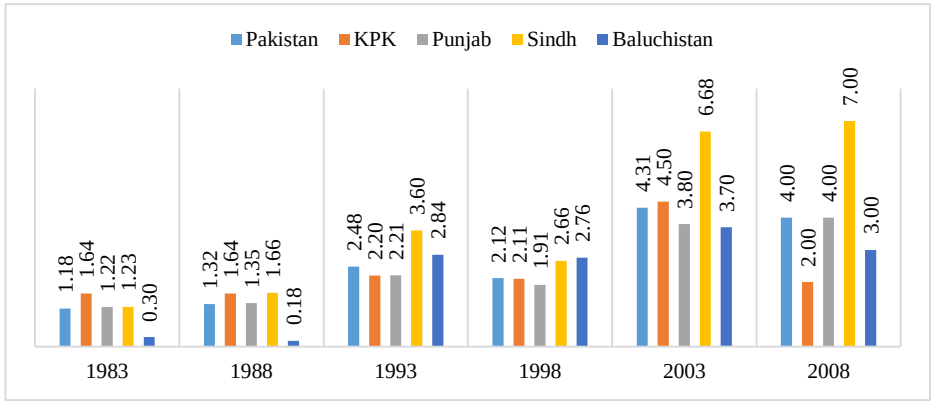
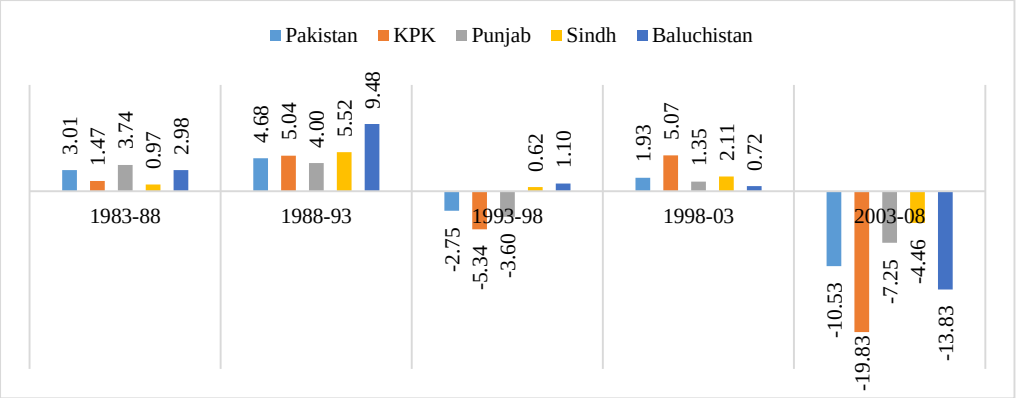


Figure 4.19 Girls College



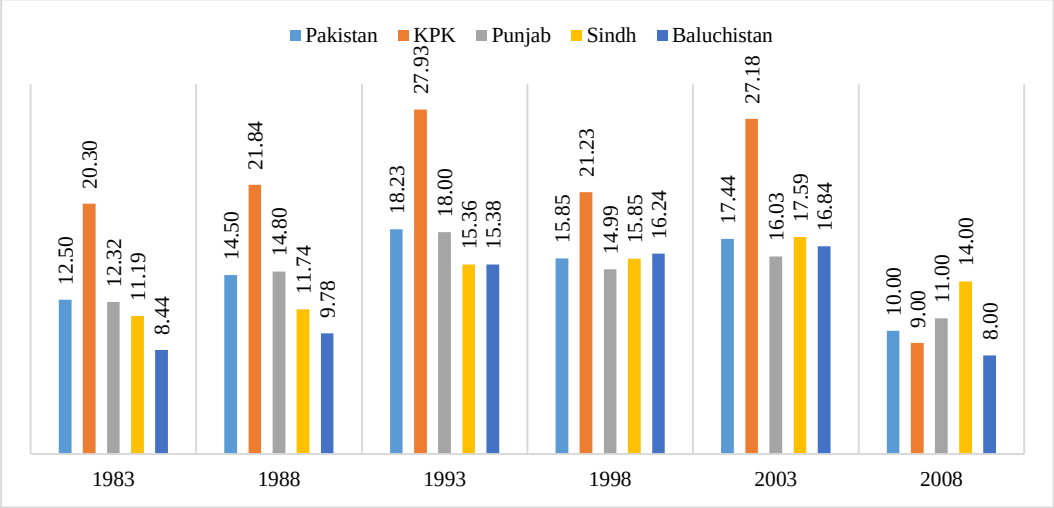
Health facility means, the availability of anyone of the following facilities within the vicinity of less than 1 kilometer of the Mouza; Dispensary, Rural health center and civil hospital. The maximum 9% per year growth of health facility were recorded in Baluchistan during 1988 to 1993. In this period of 1988-1993, the Punjab has recorded minimum per year growth of 4%. Further details are illustrated in figure 4.20.

Figure 4.20 Growth of Health Facility



When we analyze the percentage availability of health facility, we find that KPK was leading in health facility throughout the history except 2008. In 2008 this position was grabbed by Sindh, where almost 14% of the Mouzas were having health facility. During this period, Baluchistan were proceeding, where almost 8% Mouzas were having this facility.

Figure 4.21 Health Facility



CHAPTER 5

ESTIMATED RESULTS AND DISCUSSION

5.1 Introduction

This chapter presents the findings of empirical analysis of infrastructure and poverty nexus in four provinces and at country level for Pakistan during 2003 and 2008. In order to get the measure of responsiveness of poverty to infrastructure development, this study employs fixed effect model as guided by the Hausman test which clearly rejects random effect in favor of fixed effect model due to given characteristics of community level data. Hence, the results of random effect model are not reported here.

In section 5.2, the overall results of fixed effect model for Pakistan are presented and section 5.3 illustrates the results of fixed effect model for four provinces of Pakistan. In this way we would capture overall impact of infrastructure on poverty reduction in Pakistan and we would be in a position for doing comparative analysis among provinces. Section 5.4 of this chapter incorporates the discussion about national and provincial level estimated results.

5.2 Overall Analysis

The estimated results for Equation[6] 4.2 for overall Pakistan is presented in Table 5.1 and Table 5.2 contains the results for overall Pakistan.

[6] Chapter 4

Table 5.1 Fixed Effect Estimates for Poverty and Infrastructure

INDEPENDENT VARIABLES	COEFFICIENTS	STANDARD ERRORS	PROBABILITY
CONSTANT	0.6722	0.048163	0.0000
PHYSICAL INFRASTRUCTURE	-0.4322	0.0597488	0.0000
SOFT INFRASTRUCTURE	-0.1105	0.1015252	0.2760
DEMOGRAPHIC INDEX	-0.1054	0.0666335	0.0980
BANKING FACLITY	-0.0016	0.0015298	0.2910
NUMBER OF OBSERVATIONS	166	R Square	0.408
NUMBER OF GROUPS	83		

The results show that the physical infrastructure has a significant and negative effect on poverty in Pakistan. The estimated coefficient is -0.43 and is significant at 1 percent level of confidence. It shows that if rural physical infrastructure develop by 1 percent, it leads to 0.43 percent reduction in rural poverty in Pakistan. As discussed in chapter 4, infrastructure development reduces the poverty level through direct and in-direct ways. As, physical infrastructure indirectly becomes the pre-condition for all productive activities which leads to increase in entrepreneurship, economic diversification and raising income level of masses. In addition to its larger indirect impact, investment in rural physical infrastructure directly impacts poverty through providing more employment opportunities and increased farm/non-farm productivity. Our results about physical infrastructure are in line with the findings of Majumder (2012) and Nadeem *et al.* (2011). Their findings also suggests that physical infrastructure had a better tendency in reducing poverty as compared to soft infrastructure.

As for as, soft infrastructure is concerned, it has the sign according to theory however its coefficient is not significant at national level. This clearly demonstrates that comparatively investing in rural physical infrastructure had a better potential to curb poverty in Pakistan. But findings of Ogun

(2010) suggests that soft infrastructure can reduce poverty more than physical infrastructure, which are not replicated in our study. Main reason behind this disagreement may be that the density/percentage availability of soft infrastructure facilities in rural areas are far short then the minimum level of urban areas. This less percentage availability of soft infrastructure is discussed in chapter 5 of this study. That might be one of the possible reasons that is why soft infrastructure does not effectively contributing towards poverty reduction in rural areas of Pakistan.

The estimated results reported in Table no. 5.1 shows that the coefficient of demographic index proved to be significant and negatively related with poverty at 10% level of confidence. Household Characteristics (HHS, HHHA), which are incorporated in our model through demographic index proved to be reducing poverty in overall Pakistan. Estimated coefficient shows that 1 percent improvement in demographic characteristics would lead to 0.10 percent reduction in overall poverty in Pakistan. Which clearly indicates that the negative impact of HHHA dominates the positive impact of HHS and shows that lower the age of household head the higher would be his average income and his chances of being poor decreases significantly. Our results regarding household characteristics are in line with Ahmad (2013).

Similarly, our results regarding banking facility is according to theory (banking facility helps in poverty reduction) but results are insignificant. It is argued that, in developing countries the financial sectors especially the banks failed to serve the poor's. The main reason, why the banks failed to reduce poverty is that banking facility is less often available at the level of Mouza and if it is available, then it is available at distant place from the mouza. Therefore banks failed to formalize the rural economy in Pakistan. Our results regarding banking facility are similar to Khandker and Koolwal (2010). The result reported in Table no. 5.1, shows that R square statistics are 40%, which shows our Equation 4.2 is good fitted because most of the variation of the model is explained by R statistics.

Table 5.2 Poverty and Independent Variable Fixed Effect Estimates

INDEPENDENT VARIABLES	COEFFICIENTS	STANDARD ERRORS	PROBABILITY
CONSTANT	0.7165170	0.0961023	0.000
ELECTRIFIED	-0.0033933	0.0009354	0.000
DRINKING WATER	-0.0005324	0.0022818	0.816
IRRIGATION FACILITY	0.0008086	0.0003098	0.009
POLICE STATION/ POST	0.0019306	.0036687	0.599
METAL ROADS	-0.0017073	0.0007885	0.030
C.HOSP/ DISP/ RHC	0.0005990	0.0012224	0.624
BOYS PRIMARY	-0.0010541	0.0006982	0.131
BOYS MIDDLE	0.0030848	0.0011549	0.008
BOYS HIGHHSEC	0.0031239	0.0018551	0.092
BOYS COLLEGE	-0.0005597	0.0013943	0.688
GIRLS PRIMARY	-0.0004074	0.0007215	0.572
GIRLS MIDDLE	-0.0033094	0.001563	0.034
GIRLS HIGHHSEC	-0.0043940	0.0023313	0.059
GIRLS COLLEGE	0.0019877	0.0019202	0.301
VOCATIONAL CENTER	-0.0009672	0.0022493	0.667
SIZE OF HH	0.0011527	0.0074023	0.876
HH HEAD AGE	-0.0000539	0.0013137	0.967
NUMBER OF OBS	166	R Square	0.6933
NUMBER OF GROUPS	83		

Country level fixed effect estimates, which are illustrated in Table no. 5.2 shows that the major components of physical infrastructure (Electrification and Rural Roads) have negative relationship with

poverty. Though the estimated coefficients are small but significant at 1% and 5% level of confidence interval. The main channel through which electrification and rural roads affect poverty is the improvement of farm and non-farm activities through reduced cost of production, better linkages between producers and consumers, better transportation facilities, reduction in cost of transportation which leads to reduction in production cost. Our results are in line with the findings of Ahmad (2013), Ranamagar (2013), Arif and Nasir (2009), Kwon (2000), Fan *et. al.* (2004), and Seetanah (2009) but Khandkher and Koolwal (2010) argues that roads don't significantly contribute towards poverty reduction though electrification does.

Availability of irrigation facilities in the region plays a significant role in enhancing the farm production and wages, reducing poverty and income inequality. Estimated coefficient for canal water irrigation facilities for overall Pakistan, is significant in our study but it is not effectively reducing poverty in rural areas of the country. It is justifiable on the grounds that, in Pakistan agriculture sector is characterized by strong inequality in distribution of assets, particularly land and water. Only 2 percent of the households control more than 45 percent of the land. Moreover subsidies on water and agriculture are captured by the large farmers and poor people fail to avail these benefits.

Results of our study, don't give clear picture for variables of soft infrastructure in Pakistan and suggests mixed results. In Pakistan the availability public provisions like Police stations, drinking water and Health facilities are below the subsistence level, therefore these facilities are not significantly contributing towards poverty alleviation. In health facilities our results are in line with Kwon (2000) and Nadeem et. al. (2011) but our results are not in confirmation of Ahmad (2013). As far as, the education is concerned, the boy's primary and college level education facilities have expected signs, but their values are not significant. Moreover, boy's middle and high schools facilities show significant results but they are not proved to be pro-poor. These results can be explained on the basis lower percentage availability of middle and high schools in overall Pakistan. On the other hand girl's middle

and high school educational facilities gives expected negative signs and significant values simultaneously. Which shows that the quality of girl's middle and high school facilities are better in Pakistan, therefore it is helping in poverty reduction in overall Pakistan. Furthermore, these results indicate that in rural areas of Pakistan, the quality and quantity of boys educational facilities are not up to marks and that is why it is not effectively contributing towards poverty reduction significantly. These results can be explained on the basis, that availability of education facilities leads to availability of skilled labor force, which improves their productivity and income hence it acts as major determinant of rural poverty reduction in Pakistan. Coefficients of household level characteristics, gives expected signs but their values are insignificant and gives the impression that at country level, household level characteristics fails to explain changes in poverty.

5.3 Provincial Analysis

In this section, we would extend our analysis to provinces of Pakistan and try to capture the scenario prevailing in each province and compare it with other provinces. Which would enable us, in drawing up different policy interventions keeping in views provincial differences, in natural resources endowments, availability of infrastructure facilities and other agro-climatic heterogeneities.

Table 5.3 Provincial Level Fixed Effect Estimates

Independent Variables	Baluchistan	KPK	Punjab	Sindh
Constant	0.7043 (0.0650)	0.5007 (0.1502)	0.6015 (0.1230)	-0.2335 (0.2120)
Physical Infrastructure	-0.4879*** (0.1285)	0.1997 (0.1846)	-0.2586** (0.1375)	0.9203*** (0.2763)
Soft Infrastructure	0.2790* (0.1727)	-0.6623*** (0.2052)	-0.5072** (0.2145)	-0.3574* (0.2043)
Demographic Index	-0.0999 (0.1192)	-0.0911 (0.1426)	-0.1365 (0.1260)	-0.3508* (0.1779)
Banking facility	-0.0060** (0.0030)	0.0035 (0.0023)	0.0010 (0.0037)	0.0279** (0.0100)
Number of observations	30	38	68	30
Number of Groups	15	19	34	15
R Square	0.4495	0.1398	0.2009	0.0728

Note: Figures in parenthesis are Standard Errors. *, ** and *** denotes significance at 10, 5 and 1% levels respectively.

Provincial level estimated results shows that physical infrastructure had a vital and significant role in curbing poverty in Baluchistan and Punjab. However in KPK it shows insignificant results and in Sindh results are significant but physical infrastructure failed to reduce poverty in Sindh. Furthermore, estimated coefficients shows that 1 percent increase in the investment in rural Physical infrastructure in both provinces would lead to highest poverty reduction in Baluchistan (almost 0.49 percent) and lowest in Punjab (almost 0.26 percent). The channel through which the infrastructure facilities, affects poverty remain same as discussed earlier.

As far as, the soft infrastructure is concerned its coefficients are negative and significant for all provinces except for Baluchistan where these coefficients are significant but positively related with poverty. It means that in Baluchistan, the quality of education and health facilities are not up to mark and therefore these facilities failed to actively reduce poverty.

Coefficients of demographic index is negatively correlated with poverty in all provinces and its value is significant for Sindh only. As far as the banking facility is concerned, there is negative and significant relationship between banking facility and poverty, only for Baluchistan, for Sindh its value is significant but it is not helping the poor people to get rid of poverty. In all other provinces, banking facility proved to be insignificant.

Provincial level fixed effect estimated results are provided in Table 5.4. Electrification of the rural Mouzas of the districts have reduced poverty significantly in Baluchistan, Punjab, Sindh and it failed to reduce poverty in KPK. Coefficients of Piped drinking water facilities have proved to be insignificant in elimination poverty across all four provinces. Estimated results showed that irrigational facility is significant in Punjab only where it failed to curb poverty due to land management system as explained earlier.

Table 5.4 Provincial Level Fixed Effect Estimates

Independent Variables	Baluchistan	KPK	Punjab	Sindh
Constant	0.479552 (0.1765)	-0.3723 (0.5925)	1.0795 (0.1705)	0.8872 (0.3566)
Electrified	-0.0052*** (0.0012)	0.0031 (0.0018)	-0.0055*** (0.0013)	-0.0030* (0.0018)
Drinking Water	0.0011 (0.0023)	-0.0004 (0.0007)	-0.0012 (0.0013)	0.0005 (0.0036)
Irrigation facility	0.0012 (0.0010)	0.0018 (0.0019)	0.0021*** (0.0003)	0.0012 (0.0014)
Metal Roads	0.0021 (0.0025)	-0.0006 (0.0043)	-0.0019* (0.0010)	0.0003 (0.0018)
Police Station/ Post	-0.0007 (0.0030)	-0.0191** (0.0061)	0.0081* (0.0047)	0.0043 (0.0030)
C.Hosp/Disp/Rhc	0.0006 (0.0023)	-0.0063** (0.0020)	-0.0020 (0.0021)	-0.0066* (0.0042)
Boys Primary	0.0039** (0.0018)	0.0166** (0.0047)	-0.0006 (0.0008)	-0.0021 (0.0024)
Boys College	-0.0028 (0.0043)	-0.0096 (0.0086)	-0.0070 (0.0084)	0.0007 (0.0044)
Girls Primary	-0.0007 (0.0024)	-0.0047 (0.0046)	-0.0005 (0.0007)	0.0009 (0.0019)
Girls College	-0.0027 (0.0052)	-0.0141** (0.0040)	0.0024 (0.0081)	-0.0030 (0.0052)
Vocational Center	0.0072 (0.0122)	-0.0141 (0.0102)	0.0035 (0.0043)	-0.0042 (0.0038)
Size of HH	-0.0102 (0.0138)	-0.0149 (0.0086)	-0.0157 (0.0143)	-0.0245 (0.0243)
HH Head Age	0.0020 (0.0031)	-0.0019 (0.0019)	-0.0027** (0.0014)	-0.0011 (0.0047)
Number of Observations	30	38	68	30
Number of Groups	15	19	34	15
R Square	0.7075	0.1191	0.7721	0.4404

Note: Figures in parenthesis are Standard Errors. *, ** and *** denotes significance at 10, 5 and 1% levels respectively.

In Punjab, role of metal roads were significant in curbing poverty, in other provinces metal roads failed to reduce poverty significantly. One possible reason could be that, the percentage

availability of metal roads is highest in Punjab almost 80%, and in all other provinces this proportion is quite low, that is why metal roads are not directly effective in other provinces. Police station proved to be significant and negatively correlated with poverty in KPK only, in Punjab this facility have significant value but it is no more pro-poor and results for Baluchistan and Sindh are insignificant.

The estimated coefficients for boy's college education facilities are not significant in all the provinces. The results shows that coefficients of boy's primary schools facilities are significant in Baluchistan and KPK but it failed reduce poverty. However, girl's college facilities proved to be negatively correlated with poverty in KPK only. All values for other educational variables proved to be insignificant. These provincial level estimates show that vocational training centers have failed to give significant values and expected signs. In household level characteristics, only HHHA proved to be significant in reducing poverty in Punjab only.

5.4 Comparative Analysis

The data reports that poverty is higher in those districts which have less infrastructure facilities like Shangla, Dera Bugti, Musakhel and poverty is lower in those district where better facilities are available like Jhelum, Sahiwal, Quetta, Karachi and Haripur. Literature suggests that better infrastructure facilities affect poverty through direct and indirect channels**.** Empirical results confirms the presence of direct and indirect links between poverty and infrastructure. For better understanding and comparison purpose, we have constructed Table 5.5 which compares empirical findings for different facilities at national and provincial levels in Pakistan.

The overview of the results shows that physical infrastructure have significant and negative impact on poverty at national and provincial level except for KPK. Soft infrastructure, leads to poverty reduction across all provinces other than Baluchistan. At country level its impact is according to the theory however it is not statistically significant.

Table 5.5 Significance of Estimated Results

Estimated Results	Overall	Baluchistan	KPK	Punjab	Sindh
Physical Infrastructure	-ve (significant)	-ve (significant)	+ve (insignificant)	-ve (significant)	-ve (significant)
Soft Infrastructure	-ve (Insignificant)	+ve (significant)	-ve (significant)	-ve (significant)	-ve (significant)
Demographic index	-ve (Significant)	-ve (Insignificant)	-ve (Insignificant)	-ve (Insignificant)	-ve (significant)
Banking facility	-ve (Insignificant)	-ve (significant)	+ve (insignificant)	+ve (insignificant)	+ve (significant)
Electrification	-ve (significant)	-ve (significant)	+ve (insignificant)	-ve (significant)	-ve (significant)
Irrigation Facility	+ve (significant)	+ve (insignificant)	+ve (insignificant)	+ve (significant)	+ve (insignificant)
Metal Roads	-ve (significant)	+ve (insignificant)	-ve (Insignificant)	-ve (significant)	+ve (insignificant)
Health facility	+ve (insignificant)	+ve (Insignificant)	-ve (significant)	-ve (Insignificant)	-ve (significant)

As for as the demographic characteristics are concerned, it shows significant and negative relationship at country level and in Sindh province. However in other provinces, it gives results according to the theory but not significant results. As for as the Banking facility is concerned it gives negative and significant results for Baluchistan only. Electrification of the Mouzas shows negative and significant results for overall country and all provinces except KPK. Irrigational facility shows positive and significant correlation with poverty at national level and in Punjab however it has insignificant relationship for other provinces. Metal roads facilities shows significant and negative relationship with poverty at national level and in province of Punjab, in Baluchistan and Sindh it shows positive and insignificant results. In KPK and Sindh health facility shows significant and negative relationship, however at national level and in Baluchistan province it shows positive and insignificant relation with poverty.

Chapter 6

Conclusion and Policy Recommendation

In this study, we have investigated the role of rural infrastructure in reducing poverty across the rural areas of Pakistan. For this purpose, this study has obtained district level community characteristics from Pakistan Mouza Statistics which is published by Agriculture Census Organization. In addition to this, we have used the data regarding household characteristics from Pakistan Social and Living Standard Measurement (PSLM) which is published by Pakistan Bureau of Statistics. We have used Principal Component Analysis (PCA) to construct Physical, Soft and Demographic indices. In order to explore the rural infrastructure poverty nexus this study has done both descriptive and empirical analysis (for empirical analysis we used panel fixed effect technique). In this chapter we would conclude the findings of both descriptive as well as empirical results.

The descriptive analysis shows that Punjab have almost 93% of the Mouzas with electrification facility, which is highest among provinces. Baluchistan is standing at last no. among provinces in electrification facility. Similarly in metal roads Punjab is again leading and Baluchistan is proceeding all provinces. In canal water irrigational facility, Sindh has lead over other provinces and Baluchistan has still acquired the last position among provinces. In health and education facilities for both boys and girls, Sindh has taken overall lead, on the other hand Baluchistan has least no. of Mouzas with boys and girls educational facilities.

According to empirical results of the study, the community level characteristics proved to be vital in eliminating poverty across Pakistan especially the Physical infrastructure have the highest potential towards poverty reduction. However, the empirical findings suggest that the quality of soft infrastructure facilities are not enough, hence it is not successfully performing, its due role in poverty

elimination across rural areas of Pakistan. Furthermore, the household level characteristics proved to be significant in poverty reduction.

Empirical findings for provinces suggest that physical infrastructure has proved to be helpful in reducing poverty in Baluchistan and Punjab only and in addition to this Baluchistan has the higher responsiveness of poverty to infrastructure development. An important finding emerged out of provincial estimates which suggests that, the soft infrastructure is a major tool in poverty reduction across all provinces except Baluchistan.

Further, the provincial level estimates reveal that electrification of the Mouzas can reduce poverty in all provinces except for KPK. Better access to metal roads can reduce poverty in Punjab only. Another interesting finding of the study, suggests that in KPK Police stations can reduce poverty through better community level characteristics. Finally, the most important conclusion of the study is that girl's education facilities have higher potential towards poverty reduction in Pakistan as compare to boy's educational facilities.

As the finding of the study suggest that in rural areas of Pakistan the role of rural physical infrastructure proved to be the best tool in combating poverty, then comes the role of soft infrastructure facilities. Following implications have emerged out of empirical findings of the study:

- Government should define its priorities regarding infrastructural investment top priority should be given to electrification of Mouzas, then to roads and then invest funds in improvement of irrigational system as suggested by this study. Government should make proportionate investment in all these sectors giving priority to rural electrification and roads.
- In Baluchistan government should invest in electrification project because this could reduce the poverty at most, through better employment opportunities. Secondly, in Baluchistan banks

have comparatively better role in reducing poverty so government should promote the role of banks.

- In KPK, the role of public services is best among provinces for example, police stations, public health and girl education facilities have significant potential in poverty reduction. So government should improve the investment in health and girls education in KPK.
- In Punjab, best results in poverty reduction could be achieved through investment in rural electrification, then comes the role of irrigational facility and rural roads. Punjab have lower percentage availability of irrigational facilities. Though the coefficient of electrification is greater but it already have better availability of electrification facilities. Therefore, it is recommended that Punjab should invest maximum amount in irrigational projects because greater margin of improvement is available here.
- In Sindh, electrification of Mouzas and public health facility are better tools in fighting with poverty. Sindh is leading in health facilities then other provinces and stands at second no. in electrification of Mouzas. Sindh has a better margin in improving its heath facilities. So it should invest maximum amount in public health facility (because coefficient of health facility is greater) and give second priority to electrification projects.
- In Pakistan, land management system is such that per adult share of land keeps on falling by each generation and therefore their share in irrigational facility also falls with passage of time. Therefore, government should devise plans to improve the availability of greater proportion of share in irrigational facility for small farmers (or at least provide them other subsidized sources of irrigational facilities like tube wells etc.).
- As the findings of the study suggest that, investing in girls educational facilities can better translate in poverty reduction of the rural masses. Therefore, government should invest more in girls schooling.

- This study finds vocational training centers to be having insignificant results, therefore government should try to bring, these centers at grassroots level which would ultimately lead to skilled labour force which is expected to reduce poverty.
- Finally, government should ensure the availability of banks at Mouza level so that the banks can perform their active role in formalizing of rural economy.

The Way Forward

As discussed earlier, Mouza Statistics are not frequently available but it is very useful data base it would be good if all the data base (Mouza Statistics) is easily accessible for everyone, then the researchers can probably come up with better research. With the passage of time the administrative units has been changed and previous data was on previous administrative bases and latest data is on new administrative bases. Therefore, it is again difficult to combine previous data with latest data set. An extensive research is needed to develop a harmonised data bank on Mouza Statistics. Especially covering the variables of rural infrastructure. Furthermore this research can be extended to tackle with the endogeneity issues of these infrastructure facilities. In this regard we are struggling with the instruments due to data limitations. In future this research can be extended to incorporate endogeneity using external instruments.

REFERENCES

Ahmad, M. (2001). "Poverty Across the Agro-Ecological Zones in Rural Pakistan."

Ahmad, R. I. (2013). Rural Development, Economic Growth And Poverty Evidence From Pakistan, Bahauddin Zakariya University, Multan.

Ahmad, R. I. and S. Malik (2012). "Rural Infrastructural Development and Economic Growth: A Time-Series: Evidence from Pakistan (1981-2010)." Australian Journal of Business and Management Research 2: 51-57.

Ahmed, V., et al. (2013). Public Infrastructure and Economic Growth in Pakistan: A Dynamic CGE-Microsimulation analysis. Infrastructure and Economic Growth in Asia, Springer**:** 117-143.

Alex, Riley., Tanya, Bathiche. (2006). Poverty Reduction and Transportation Infrastructure in Timor-Leste. Papers for Poverty Reduction in Conflict and Fragile States by USAID.

Ali, I. and E. M. Pernia (2003). "Infrastructure and Poverty Reduction-What is the Connection?".

Anderson, E., et al. (2006). "The Role of Public Investment in Poverty Reduction: Theories." Evidence and Methods.

Arif, G. M. and Iqbal. N. (2009). Infrastructure-Poverty Nexus in Rural Pakistan. Socio-Economic Challenges Faced by Pakistan.

Arif, G. M. and S. Farooq (2011). "Poverty, Inequality and Unemployment in Pakistan." Background study for IDB group MCPS Document for Pakistan. Dhul-Qa'dah H 1432.

Arif, N. and A. Nazim (2012). "Clustered Deprivation: District Profile of Poverty in Pakistan." Sustainable Development Policy Institute (SDPI).

Asghar, N., et al. (2012). "Government Spending, Economic Growth and Rural Poverty in Pakistan,"." Pakistan Journal of Social Sciences (PJSS) Vol 32: 469-483.

Cheema, I. A. (2010). Tracing the Spatial Dimensions of Poverty, Working Paper 2010-02, Oxford Policy Management, UK.

Dinkelman, T. (2011). "The Effects of Rural Electrification on Employment: New Evidence from South Africa." The American Economic Review: 3078-3108.

Fan, S., et al. (2005). Public investment and poverty reduction in Tanzania, International Food Policy Research Institute (IFPRI).

Government of Pakistan. (1983). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization

Government of Pakistan. (1988). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization

Government of Pakistan. (1993). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization

Government of Pakistan. (1998). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization

Government of Pakistan. (2003). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization.

Government of Pakistan. (2004-05). Pakistan Social and Living Stanadards Measurement Survey. Pakistan Bureau of Statistics.

Government of Pakistan. (2008). Pakistan Mouza Statistics (Settled Areas). Agriculture Censes Organization.

Government of Pakistan. (2008-09). Pakistan Social and Living Stanadards Measurement Survey. Pakistan Bureau of Statistics.

Government of Pakistan. (2013-14). Economic Survey of Pakistan. Mininstry of Finance, Pakistan.

Irfan, M. (2007). "Poverty and Natural Resource Management in Pakistan." The Pakistan Development Review: 691-708.

Jamal, H. (2007). Income Poverty at District Level: An Application of Small Area Estimation Technique, Social Policy and Development Centre.

Jan, S. A., et al. (2012). "Physical Infrastructure and Economic Development in Pakistan."

Khandker, S. R. and G. B. Koolwal (2010). "How Infrastructure and Financial Institutions Affect Rural Income and Poverty: Evidence from Bangladesh." The Journal of Development Studies 46(6): 1109-1137.

Khandker, S. R., et al. (2006). "The Poverty Impact of Rural Roads: Evidence from Bangladesh." World Bank Policy Research Working Paper (3875).

Kwon, E. (2005). "Infrastructure, Growth, and Poverty Reduction in Indonesia: A Cross-Sectional analysis." Asian Development Bank, Manila. Processed.

Majumder, R. (2012). "Removing Poverty and Inequality in India: The Role of Infrastructure."

Nadeem, N., et al. (2011). "Impact of Social and Physical Infrastructure on Agricultural Productivity in Punjab, Pakistan-A Production Function Approach." Pakistan Journal of Life and Social Sciences (Pakistan).

Ogun, T. (2010). Infrastructure and poverty reduction: implications for urban development in Nigeria. Urban Forum, Springer

Peter, H., et al. "Impact of Public Expenditure on Poverty in Rural India." Economic and Political Weekly 35(40): 3581-3588.

Ramessur, S., et al. (2010). "Roads and poverty: New evidences from Africa." Journal of Poverty 14(2): 166-182.

Ranamagar, U. (2013). "The Impact of Infrastructural Facilities on the Poverty of Farmers in Bidur Municipality, Nepal." International Journal of Agriculture System 1(1): 55-64.

Sahoo, P., et al. (2010). "Infrastructure Development and Economic Growth in China."

Seetanah, B., et al. (2009). "Does Infrastructure Alleviate Poverty in Developing Countries ." International Journal of Applied Econometrics and Quantitative Studies 6(2): 31-36

Siddiqui, R. and K. P. Pant (2007). "Quantifying the Impact of Development of the Transport Sector in Pakistan [with Comments]." The Pakistan Development Review: 779-802.

Straub, S. (2011). "Infrastructure and Development: A Critical Appraisal of the Macro-Level Literature." The journal of development studies 47(5): 683-708.

Wanmali, S. and Y. Islam (1995). "Rural Services, Rural Infrastructure and Regional Development in India." Geographical Journal: 149-166.

Warr, P. (2005). "Road Development and Poverty Reduction: The Case of Lao PDR."