

**Impact of CPEC Projects on Agriculture Sector
of Pakistan: Infrastructure and Agricultural
Output Linkages**

Riaz Ahmed

**PhD Scholar, Department of Economics,
Preston University Islamabad Campus**

and

Usman Mustafa

**Professor and Head, Department of Business Studies,
Pakistan Institute of Development Economics,
Islamabad**

ABSTRACT

Formation of regional and global strategic movements around the world in present century has led to geo- strategic and geo-economical partnerships among countries. China Pakistan Economic Corridor (CPEC) is one of the best examples of such partnerships. The overall launching time span of CPEC spreads from 2014 to 2030. There are three phases for implementation of the projects under CPEC. The short-term, midterm-term and long-term projects are estimated to be completed by 2017, 2025 and 2030 respectively. The estimated construction cost for these projects is \$46 billion. It is the network of highways, railways, pipelines, transport, oil, gas and energy. Agriculture sector would be a direct as well as indirect beneficiary of CPEC via development in backward and forward linkages. Agriculture has been backbone of low-income economies. It is generally the primary source of income and employment in rural areas. Agriculture sector of Pakistan has continuously been facing downfall during the last one decade. Worst energy crisis during the recent years might be one of the major reasons behind such down turn. The paper has been prepared to see the impact of development of infrastructure on growth of agriculture sector. Also critically assessing the explicit and implicit economic benefits that can be gauged from various initiatives of CPEC particularly the infrastructural development. A thorough literature has been scanned to achieve this objective. Given all ifs and buts, the development of infrastructure including energy projects under CPEC plan will help in uplifting the agriculture. It is imperative that governments at all levels should support and back up these projects through institutional development and regulatory mechanism so that maximum economic benefits could be reaped.

Key words: Pakistan, CPEC, Agriculture sector, infrastructure

1. Introduction

Formation of regional and global strategic movements around the world in present century has led to geo-strategic and geo-economical partnerships among countries. States have defined their interests by reshaping their policies. They have realized that it is not possible for them to protect their interests with their own capacities. High-level talks and diplomatic consultations have got great importance. All nations are trying their best to promote cooperation among one another in multi-faceted fields. These fields include infrastructure development programs, industrial ventures, commerce, defense and other related areas of the economy. China Pakistan Economic Corridor (CPEC) is one of the best examples of such partnerships (Noor et al., 2008).

By implementations of these projects Pakistan would gain great importance not only in this region but in the entire world. In recent years, both China and Pakistan have been making their best efforts to start mega projects beneficial for the interest of both of the nations. The Silk Road is one of the oldest, shortest and the most important trade route in the world. It will prove a great help for trade to be carried from Kashgar (China) to Gwadar (Pakistan). Pakistan will become strong economically through implementation of China-Pakistan Economic Corridor plan (Iqbal and Anwar, 2015).

There are three phases for implementation of the projects under CPEC. The short-term, midterm-term and long-term projects are estimated to be completed by 2017, 2025 and 2030, respectively. The estimated construction cost for these projects is \$46 billion. It is the network of highways, railways, pipelines, transport, oil, gas and energy. Agriculture has been backbone of low-income economies. It is generally the

primary source of income and employment in rural areas. Agriculture sector would be a direct as well as indirect beneficiary of CPEC via development in backward and forward linkages (Jawad and Rana,2013).

As CPEC includes a network of infrastructure development programs, so the study has tried to find the association between development of infrastructure and growth in agriculture sector. There is direct association between various types of infrastructure and agricultural output growth (Antle, 1984). Rural electrification increases irrigated area, improves irrigation facilities and as a result the output of crops cultivated through underground irrigation system is always higher than those under canal or tank irrigation (Barnes and Binswanger, 1986; Dhawan, 1988; Vaidyanathan et al., 1994; Shah et al. 2006). Furthermore, it also helped in chilling process of milk which help in postharvest losses reduction,

Green revolution is a package consisting of a network of infrastructure development programs. It has been encouraged to enhance the output in agriculture sector. A large number of studies affirm strong positive relationship between these two variables. There exists strong positive association between Green Revolution technology package and agricultural output (Evenson and Gollin, 2003; Murgai et al. 2001; Hussain and Hanjra, 2003, 2004; Saleth et al., 2003).

All of the above cited empirical studies have clearly demonstrated the nexus between the infrastructure development and agricultural growth. Almost all the studies show that there is positive and significant relationship between infrastructure development and agricultural output. In the light of these studies the key objective of the current study is to explore the expected impact of investment under current China Pakistan

Economic corridor CPEC on agriculture productivity. It also links employment generation, agriculture development, and poverty eradication.

In first section of the study a brief introduction with objectives of the study has been discussed. In second section relevant literature has been discussed in different parts including linking infrastructure and agricultural output, impact of roads infrastructure on changes in agricultural technology, impact of infrastructure on trade and poor infrastructure as a bottleneck on agriculture growth and development. In third section the required methodology to meet the objectives of the study has been presented. Results and discussion of different models and indicators are presented and elaborated in the fourth session. Conclusion of the study has been discussed in the fifth section and finally some policy implications have been discussed in the last sixth section of the study.

2. Literature Review

In this section some relevant literature has been reviewed. This section has further been sub divided into linking infrastructure and agricultural output, impact of roads infrastructure on changes in agricultural technology, impact of infrastructure on trade and poor infrastructure as a bottleneck on agriculture growth and development.

2.1 Linking Infrastructure and Agricultural Output

Agriculture has been an important part of most low-income economies. It has been primary source of income and employment in rural areas (Reardon et al., 1998; Haggblade et al., 1989). The relationship between infrastructure development and sustained output growth has been demonstrated by many international studies (Aschauer, 1989; Canning, 1998; Calderon and Chong, 2004) and reviews (Sawada,

2000; Estache et al., 2005; Pinstруп-Andersen and Shimokawa, 2006). Binswanger et al., (1987) collected data from 58 countries and found a positive and significant correlation between road development and aggregate agriculture output. These views have also been supported by many Asian studies (Ruttan, 2002; Mundlak et al., 2004). Antle (1983) found from his cross country analyses that there exists strong relationship between infrastructure and agricultural output growth. He used cross-sectional data for 47 under developed countries for this purpose.

There is direct association between various types of infrastructure and agricultural output growth (Antle, 1984). Development of irrigation infrastructure brings revolutionary changes in agricultural output. For example, it enhances the land use intensity and provides incentives to farmers to use productivity increasing inputs (Dhawan, 1988; Vaidyanathan, 1999; Shah, 1993; Narayanamoorthy and Deshpande, 2005). Rural electrification increases irrigated area, improves irrigation facilities and as a result the output of crops cultivated through underground irrigation system is always higher than those under canal or tank irrigation (Barnes and Binswanger, 1986; Dhawan, 1988; Vaidyanathan et al., 1994; Shah et al. 2006). Rural roads encourage the use of modern agricultural technology which leads to increase in agriculture output (Ahmed and Donovan, 1992; ESCAP, 2000; Van de Walle, 2002).

Better access to institutional credit decreases the cost of borrowings and hence reduces cost of production leading to higher profit and agriculture growth (Ramachandran and Swaminathan, 2002). Binswanger et al., (1993) found from their study that institutional infrastructure like markets and credit facility play a key role in the growth of agricultural sector. Better access to credit facilities enhances farm productivity and increases the level of profit (Ahmed and Hossain, 1990; Ali and Pernia, 2003).

Availability of credit increases farmer's investments in producing durables such as tractors, bullocks and implements (Rosenzweig and Wolpin, 1993). Agriculture infrastructure consists of many elements. Some elements might be more important than the others but overall impact of infrastructure is positive and significant on agriculture productivity (Binswanger et al. (1993).

There are some other studies available which advocate strong relationship between development of rural infrastructure and output growth. For instance, Datt and Ravallion (1998) conducted research by using data from many states. They showed that states having better physical and human infrastructure achieved higher rates of agricultural output growth than states with poor infrastructure. Fan et al. (1999 and 2000) studied the relationship between irrigation and roads facilities and output growth and found strong positive association between these two variables.

Kiani (2008) found positive impact of different investments on total factor productivity in Punjab. He used Almon distributed lag model for this purpose. Fan et al. (2004) analyzed that most of the government investments (agricultural research and development, irrigation, rural education, and infrastructure including roads and electricity) has positive impacts on agricultural productivity growth and rural poverty reduction.

Green revolution technology includes irrigation, research and extension, improved varieties and fertilizers. There exists strong positive association between Green Revolution technology package and agricultural output (Evenson and Gollin, 2003; Murgai et al. 2001; Hussain and Hanjra, 2003, 2004; Saleth et al., 2003). Such like relationships are apparent from studies conducted at various scales, such as at country level (Datt and Ravallion, 1998; Fan et al., (1999, 2000), state-level (Ghosh, 2002;

Bhatia, 1999), project level (Nayyer, 2002) taluka level (Gidwani, 2002; Shah and Singh, 2004), and village level (Barnes and Binswanger, 1986; Ballabh and Pandey, 1999). Likewise, there are studies which show positive and significant relationships between development of infrastructure and agricultural output (Fan et al., 2000b; Palmer-Jones, 2003; Saleth et al. 2003).

2.2 Impact of Roads Infrastructure on Changes in Agricultural Technology

Many studies are available which conclude that development of infrastructure brings revolution in agriculture technology. Woelcke (2006) found from his study that improvement in road infrastructure reduces the cost of transportation. Dercon and Hoddinott (2005) conducted a study to see the relationship between quality of roads and input purchasing power of the farmers. They provided evidence that improvement in road quality leads to increase the probability of farmers' purchasing inputs by 29 to 35 percent according to the season. Nkonya et al. (2011) found from his study that by linking farmers to extension services, communication infrastructure, the market, rural services and rural roads etc. a better returns on investment can be reaped and this would encourage farmers' decisions to adopt and invest in better land technologies used by the farmers. Yoshino (2008) analyzed that poor infrastructure adversely affect the export of agricultural output. Okoboi and Barungi (2012) show that farmers have usually low access to credit in almost all the developing countries which might a big constraint to purchase the inputs used in farms. Similarly markets located at distance are key constraints to use of fertilizers and to sell the agriculture output. They support the availability of agriculture credit at easy interest rate and easy terms and conditions. They also support the construction of infrastructure to link the farmers with markets. It

can be concluded from above presented studies that development of infrastructure is followed by positive changes in technology used in agriculture sector.

2.3 Impact of Infrastructure on Trade

There are a great number of studies available which show that there is positive association between development of infrastructure and promotion of trade. Limão and Venables (1999) found from their study that 10 percent decrease in transport cost leads to 25 percent rise in international trade. Investment in transport infrastructure and communication results in promotion of international trade as such investment reduces transport cost (Bouët et al. 2008). There are many constraints which influence the agriculture output. Moïsé et al. (2013) used a gravity model approach to see this constraint in agriculture sector. They further conclude that transport and trade-related infrastructure are very crucial for exports of agricultural products. According to study conducted by the Schacht (2010) there are weak linkages between key surplus and deficit markets in the region. The key factor behind weak linkages is constraints on productive transport along regional corridors. Study further reveals that infrastructure development should be encouraged to foster agricultural trade and market integration mechanism in developing countries.

The above cited and many other studies support the development of infrastructure for promotion of trade in agriculture trade. The development of infrastructure is encouraged because it reduces the cost of transportation and as a result deficit and surplus in agriculture sector can be avoided.

2.4 Poor Infrastructure - a Bottleneck to Agriculture Growth and Development

There are a large number of studies available which show that lack of infrastructure is a big constraint over agricultural development. The Asian Development Bank (2007) found that poor infrastructure is one of the major hurdle to attract investment in Philippines. Poor infrastructure increases the cost of doing the business. Thus poor infrastructure is great hurdle against sustainable economic growth. From the studies of Llanto (2007a) and Llanto (2007b), it is apparent that if there would be regional imbalance in infrastructure, it would leave an adverse affect on regional economic growth. According to studies conducted by Basilio and Gundaya (1997) and Manasan and Chatterjee (2003) it can be concluded that difference in availability of infrastructure results in difference in regional growth. Infrastructure can be a key variable in bringing regional convergence.

All of these studies show that poor infrastructure is one of the major hurdles against agriculture growth and development. Development of infrastructure is key factor for development of agriculture. Infrastructure might play a role of engine for growth of farm production

3. Methodology

This section of the study is crucial because it provides the required path to meet the objectives of the study. It has further been divided into following sub parts:

3.1 Review of Different Studies

As this is a review paper so different papers have been reviewed to see the expected impact of CPEC projects on agriculture sector of Pakistan. A large number of studies showing the impact of infrastructure on output growth have been consulted; similarly the studies showing impact of infrastructure on trade development have also been

taken into account. Some studies showing poor infrastructure prove bottleneck for agriculture output have also been reviewed. There are studies available in international and local literature which show that development of infrastructure leads to use of better and advanced technology and some other show that strong association exists between infrastructures and research in agriculture. A number of these studies have also been consulted to reap the required objectives.

3.2 Analytical Network of Figures

Networks of figures have been adapted from different sources to show the overall impact of infrastructure development on growth and poverty eradication. A figure showing policy phases to support agriculture transformation have been adapted from Dorward et al., (2004a,b). The figure has been used to show network of different phases which ultimately show the impact of development of infrastructure on agriculture growth. Another figure has been adapted from Andersen and Shimokawa (2007). This figure has been used to see the link between infrastructures and research and technology. To answer the question how infrastructure helps in GDP growth rate and poverty eradication? A figure has been adapted from Ali and Pernia (2003). The figure also shows the importance investment on infrastructure consisting of roads, irrigation and electricity. All of these figures have been presented in section 4 of the study.

3.3 Infrastructure in Growth Model

Infrastructure has been important in almost all the growth models. Bose et al. (2007) analyzed from their study across a panel of 30 developing countries over the 1970–1980 period that government capital expenditures are positively and significantly

related to per capita income growth. Moreno-Dodson (2006) found from his study that labour productivity is a channel whereby public infrastructure indirectly increases growth. Estache and Fay (2009) suggested that, investment in public infrastructure can bring positive change in growth.

From the studies cited above and some other it is apparent that development infrastructure and growth have positive association with each other. Infrastructure has an effect on any given measure of output via two channels. Directly as a production factor of production and indirectly by influencing total factor productivity (TFP). The general production function has been presented as follows.

$$Y = A (Kp) f (K, L, Kp)$$

Where:

Y is Growth in output, K is Capital, L is Labour, Kp is Public capital and A is total factor productivity.

The model shows direct relationship between public capital (investment on infrastructure) and output growth. The model is linked with CPEC projects and their expected impact on agricultural output.

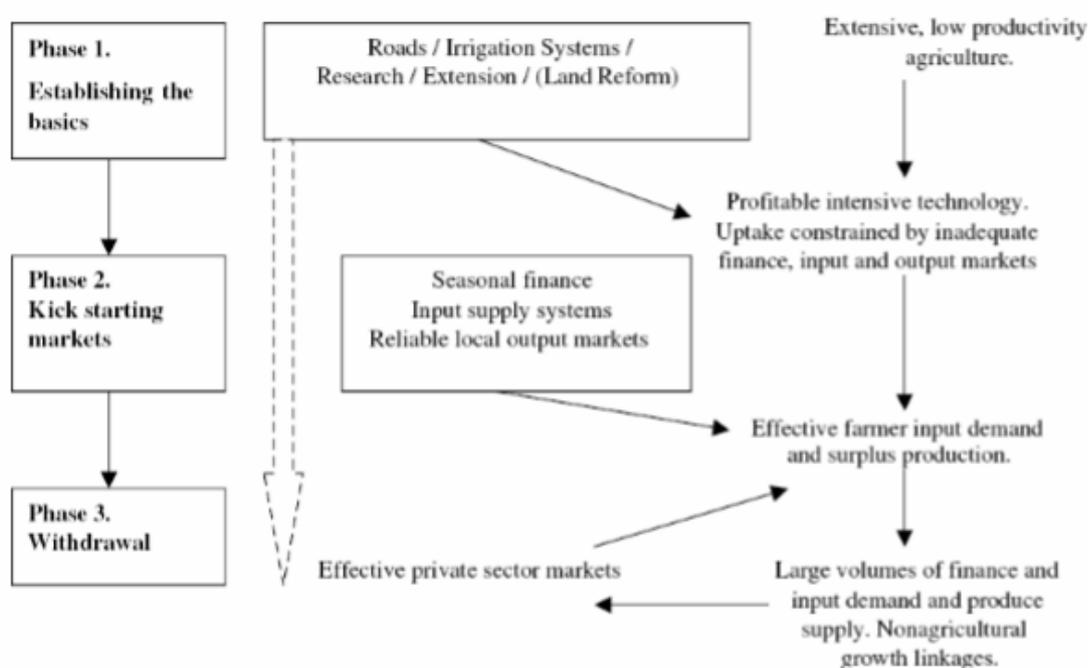
4. Result and Discussion

In this section following network of figures have been presented to show link between infrastructure development and output growth in agriculture sector.

4.1 Policy Phases to Support Agriculture Transformation

Figure 1 will be helpful in understanding the policy phases to support agriculture transformation. The process of policy phases to support agriculture transformation has been shown in Figure 1, which is adapted from Dorward et al., (2004a,b).

Figure 1: Policy Phases to Support Agricultural Transformation



Source: Adapted from Dorward et al., (2004a,b).

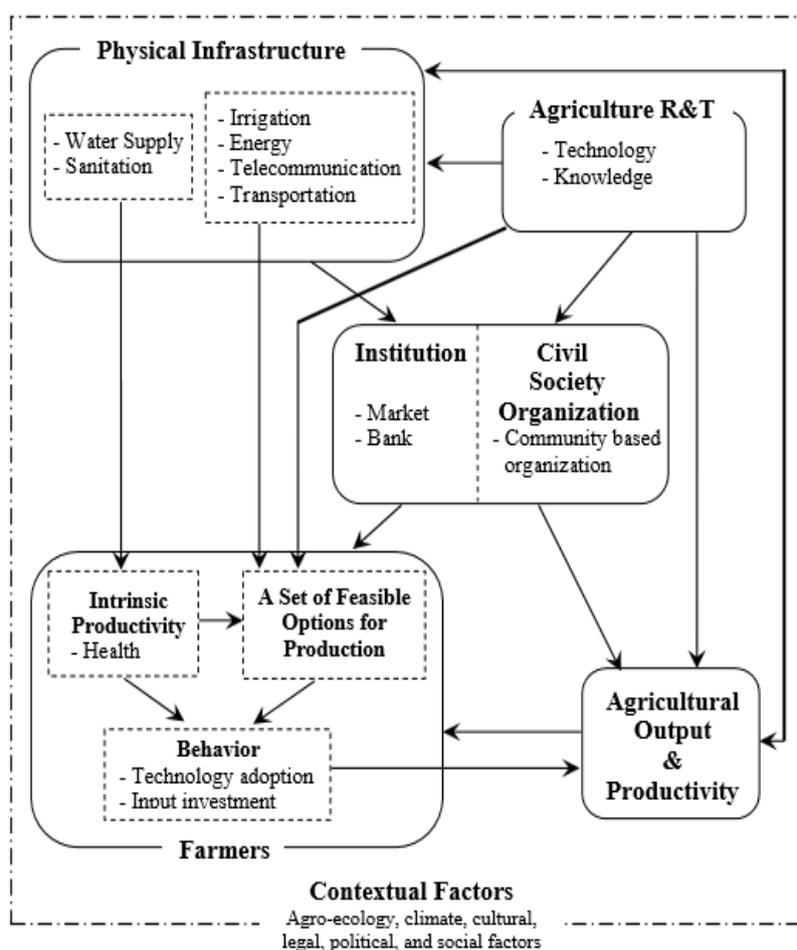
Phase 1 of the figure shows the establishment of productive technologies. In this phase small number of farmers have access to credit facilities and markets. In phase 2, government interventions take place which enables a great number of farmers to have an access to finance facilities and markets. Then phase 3 starts in which governments can withdraw from these market activities. Private sectors takes the

charge. It will be helpful in promoting the non-farm rural economy (Dorward et al., 2004a,b).

4.2 Agricultural Research and Technology and its Links to Infrastructure

Development of infrastructure is followed by research and technology in the agriculture sector. Physical infrastructure has been divided into two groups. First one includes water supply and sanitation and the other one includes transportation, energy, telecommunication, and irrigation sectors. A great number of studies are available in literature confirm that when infrastructure is built, use of modern technology becomes common in agriculture sector. For example Woelcke (2006) found from his study that improvement in road infrastructure reduces the cost of transportation and make the use technology common. The linkages between physical infrastructure, agricultural research and technology (R&T) is shown in Figure 2.

Figure 2: Analytical Framework Showing How Infrastructure effects The Agricultural Development



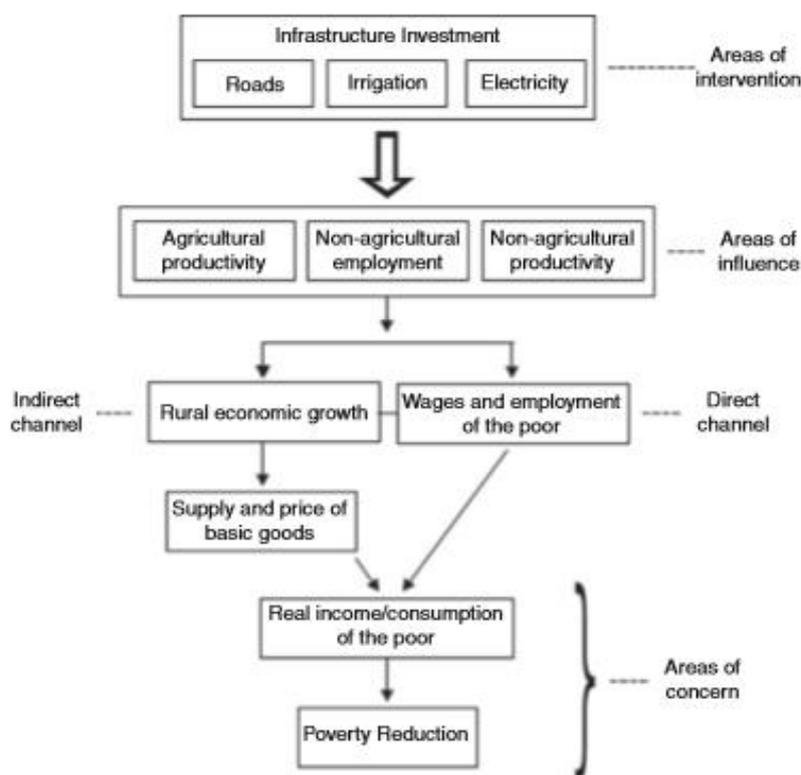
Source: Adapted from Andersen and Shimokawa (2007)

Figure 2 shows how both types of infrastructure brings positive change in agriculture productivity? It is apparent that development of infrastructure affects agriculture output positively which leads to agricultural R&T. This all shows that development of infrastructure is followed by better use of technology in agriculture sector.

4.3 Estimating the Effect of Infrastructure on Growth and Poverty Reduction

A great number of studies have been conducted to see the impact of infrastructure on growth of agriculture and poverty reduction (e.g. Lopez and Serven 2004; Fanta and Upadhyay 2009 ; Dollar and Kraay 2002). They affirm that infrastructure leads to growth and poverty reduction. Effects of infrastructure on growth and poverty reduction is shown in Figure 3.

Figure 3: Analytical Framework Showing Impact of Infrastructure on Agricultural Growth and Poverty Reduction



Source: Adapted from Ali and Pernia (2003)

The diagram shows that investment on infrastructure consisting of roads, irrigation and electricity with the help of different channels eventually enhances the real income and reduces the level of poverty.

From literature and Figures (1 to 3), it is found that development of infrastructure is followed by output growth. Thus it is expected that successful completion of CPEC projects would bring a revolutionary changes in growth of agriculture sector.

4.4. The Potential of CPEC for Agricultural Business Development

On the basis of agro-ecologies, the CPEC is divided into 10 sections (Figure 4). MNFS&R has developed a business model to promote value added agriculture on CPEC (Table 1). Business clusters for >40 commodities identified for promoting rural businesses (Khan, 2016).

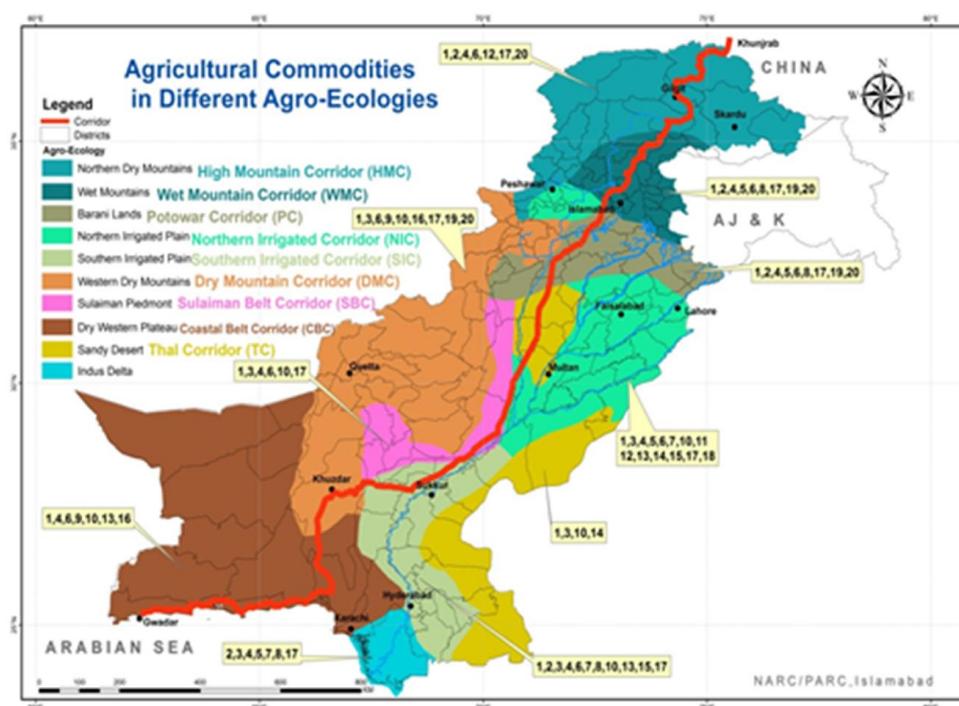
The model will help to achieve:

- a) Food sovereignty;
- b) Benefitting farmers and rural communities;
- c) Smarter food production and yields;
- d) Biodiversity conservation;
- e) Sustainable soil health and cleaner water;
- f) Ecological pest management; and
- g) Resilient food systems.

Table 1: Types of Value Added Agricultural Commodities Can be Produced in Different Agro-Climate Zones of Pakistan.

S. No.	Agro-Commodities
1	Livestock/Sheep Goat Fattening and Dairy Product
2	Aquaculture and Marine Fishing
3	Cereal and Products
4	Vegetable, Fresh and Processed
5	Poultry/Feed
6	Fruits Fresh, Dried and Processed
7	Sugar, Gur and Molasses
8	Cut Floor Production
9	Herbs and Spices
10	Animal Feed and Fodder
11	Tobacco Industry
12	Animal skin Processing
13	Seed Production
14	Pulses
15	Cotton Processing
16	Wool Cleaning and Processing
17	Plants, Nursery and Products
18	Vegetable Oil, Essential Oil, etc.
19	Olive Production and Processing
20	Honey

Figure 4. Agricultural Commodities in Different Agro-Ecological Zones Connected with CPEC.



The literature affirms strong relationship between development of infrastructure and agricultural output. This shows that projects in CPEC would play an important role in uplift of agriculture sector in Pakistan yet there are some critical questions in this regard. Is infrastructure a significant determinant of agricultural productivity? How does infrastructure affect agricultural productivity? The competition with china agriculture sector will increase which might be threatening facotor for the agriculture sector of Pakistan.It is fact that development of infrastructure will bring a positive change in agriculture output which would increase the supply of agriculture commodities but the question is, has government taken steps to export that stock as pakistan has alreedy increasing stock of rice and wheat every year? Has Pakistan devised terms and conditions with China to creat demand for its agricultural output or

if there are any terms to save Pakistan's agricultural sector from competition with that of China?

5. Conclusion and Policy Implications

5.1 Conclusion

Formation of regional and global strategic movements around the world in present century has led to geo- strategic and geo-economical partnerships among countries. China Pakistan Economic Corridor (CPEC) is one of the best examples of such partnerships. The overall launching time span of CPEC spreads from 2014 to 2030. There are three phases for implementation of the projects under CPEC. The short-term, midterm-term and long-term projects are estimated to be completed by 2017, 2025 and 2030 respectively. The estimated construction cost for these projects is \$46 billion. It is the network of highways, railways and pipelines to transport, oil, gas and energy. In the current study an attempt has been made to understand the relationship between infrastructure development and agricultural output. An effort has also been made to see the impact of infrastructure development on poverty reduction. Empirical evidence shows that there exists nexus between infrastructure, output growth and poverty reduction. The evidence presented in this paper shows that there is strong relationship between infrastructure development and agriculture output. Different channels through which infrastructure may lead to increase in agriculture output and poverty reduction have also been shown by analytical framework. There is an evidence that poor infrastructure proves a bottleneck to agriculture growth. On the basis of available literature, empirical evidences and different frameworks, it is hoped that CPEC would help a great deal in uplifting the agriculture sector in Pakistan. It

would prove a game changer in enhancing growth in output, poverty reduction and economic uplift.

5.2 Policy Implications

The study has certain policy implications. Before discussing the policy implications, the major findings of the study are presented. The results of the study affirm strong positive association between development of infrastructure and agricultural output. There exists nexus between infrastructure, output growth and poverty reduction. Development of infrastructure leads to growth and hence reduces the level of poverty. It also promotes and encourages agriculture trade. Poor infrastructure is bottleneck to growth in agriculture sector. Building of better infrastructure is followed by better use of technology. Following policy implications are suggested on the basis of these findings. As CPEC includes the network of development of infrastructure so all political parties, common masses and all other people belonging to all spheres of life should support and back up the CPEC at every level. Peace should be ensured to make the environment favorable for completion of these mega projects. Agriculture research programs might be included in CPEC plan.

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