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Rural Infrastructure and Its Impact on Agricultural Growth, Job Creation and Eradication of Poverty in India: An Empirical Analysis

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Abstract

Many agricultural shifts and transitions have taken place in India in the last fifty years. The factors that underlie these changes in different periods are different. The infrastructure facilities of a developing country such as India are typically poor and insufficient, especially in rural areas. In several states, even minimal infrastructure facilities such as public roads, irrigation and electricity are not available to rural people. There is an urgent need of accelerating the process of creation of infrastructure in rural areas if the country wants to achieve balanced and stable growth. Agriculture sector cannot grow without some basic infrastructural facilities in the form of agricultural credit, irrigation, power, transport and marketing network etc. In the absence of adequate provision, the agricultural productivity is low in India compared to other countries. In the country, the yield per hectare of different crops and amount of agricultural production among different states can largely be compared to the degree of application of agricultural inputs despite differences in land productivity and rainfall. The poor rural infrastructure constraints the access of the farmers to market and compels them to sale their produce at lower prices. The construction of rural roads becomes inevitable to market the agriculture produce at the profitable and competitive prices.

In the course of recent years, huge interests in rural infrastructure upgrades have been found out with numerous intended objectives, and varied stages of success in achieving those targets. As for physical infrastructure, one objective has essentially been to empower rural areas upgrade in water supply, roads, electricity, irrigation, and so on, to deal with obvious disparities in levels of advancement amongst urban and rural areas. A significant number of the recent rural infrastructure projects extend expressly state welfare enhancements of the poor rural as project objectives. It is far generally normal that physical infrastructural upgrades lead to financial, non-monetary, and social advantages for the poor. It was just in the wake of episodes of starvation and different ailments which tested the living state of the urban dwellers that governments took up this problem. For over a period of time now, rural development techniques have been focused at the advancement of a cutting-edge area through plan of action to fertilizers, seedling improvement, irrigation and mechanization.

Most of the poor are in rural areas, and the growth of farm productivity and non-farm rural employment is linked closely to infrastructure provision. It is estimated that 15 per cent of the crop produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers.” Economic reforms and trade liberalization were supposed to change the scenario in agriculture sector through expansion of market opportunities for primary goods exports and private investment.

Introduction

The significance of infrastructure is widely acknowledged in the worldwide debate on poverty reduction as a critical factor influencing socio-economic development, especially in rural areas. Infrastructure includes all of the essential structures and processes required for a society to run smoothly, such as energy and transportation grids, communication networks, and the provision of basic public services. Robust infrastructure may greatly reduce economic inequities and promote sustainable development in the context of rural poverty, where access to basic necessities is frequently restricted or insufficient.

Typically, there are two kinds of income activities in rural areas - farm and nonfarm activities. Within farm activities, there are some farmers (small and marginal) who are net buyers of the food and others (large farmers) net sellers of food. When prices of agriculture food rises, the real income of former drops and latters' rise. Implicitly, the terms of trade between agriculture and nonagriculture is also an important determinant of poverty incidence.

Infrastructure is an umbrella term for many activities referred to as social overhead capital by development economists as Arthur Lewis, Rosenstein-Rodan, Ragner Nurkse and Albert Hirschman. Lewis included public utilities, ports, water supply and electricity as infrastructure (Lewis, 1955) whereas Hirschman outlined four conditions that characterise infrastructure or social overhead capital: the services provided to facilitate or are basic to economic activity; the services are usually public goods because of economic externalities; these services cannot be imported; these investments tend to be indivisible or 'lumpy' (Hirschman, 1958). Later, in the sixties, besides the above, emphasis was laid on agricultural research, extension and rural financial institutions as important elements of infrastructure, due to increasing recognition of the role of agriculture in economic development and the vital role that infrastructure plays in generating agricultural growth

The World Development Report of 1994 included the following in its definition of infrastructure:-

Public utilities - power, telecommunications, piped water supply, sanitation and sewerage, solid waste collection and disposal and piped gas.

Public works - roads, major dam and canal works for irrigation and drainage. *f*

Other transport sectors-urban and inter-urban railways, urban transport, ports and waterways, and airports

Review of Literature

The relationship between infrastructure and productivity has been examined by various researchers and policymakers. As early as in 1989, Aschauer examined the productivity of public capital in US for which he brought in government expenditure as a proxy for public good in the production function. Since Aschauer's analysis did not include other determinants of output nor for fixed effects, the estimates are more likely to be affected by spurious correlations. Some authors have explored the relationship between public infrastructure and economic growth using pooled time series and cross-section data to eliminate the problems of time series data. Munnell (1990) used core infrastructure such as highway, water and sewer systems and others, and examined each type of infrastructure. Most economies that are primarily agrarian in nature have sought to investigate how agricultural productivity can be augmented through specific investments in infrastructure. Using farm level data, Segun (2008) empirically examined the place of infrastructure in agricultural productivity in Nigeria and found that rural infrastructure index had the highest positive impact on agricultural productivity. In a provincial level study, Li and Liu (2009) examined the effect of infrastructure development in agricultural production technical efficiency and established that that except telecommunications, all the other infrastructure variables had a positive impact on agricultural production. Llanto (2012) used a random effects GLS regression model and found that access to 3 electricity and paved roads had a positive and significant impact on agricultural labour productivity while irrigation had a positive but insignificant relationship with agricultural labour productivity. Some studies used the methodology of factor analysis to arrive at aggregate indices (Rao, 1990, Majumdar, 2004, Swaminathan, 2009) and examine agricultural development. For instance, a study by Majumdar (2004) which aimed at examining the relationship between infrastructural availability and development using various indices for a twenty-year time period spanning 1971-1991 at the district level found that the association of agricultural development was strongest with power infrastructure (0.21), followed by educational (0.20) and transport infrastructure (0.17). In the Indian context, Ashok and Balasubramanian (2009) employed total factor productivity approach for the districts of Tamil Nadu during 1998-99 to 2003-04 and found that irrigation, roads, markets and literacy had greatest positive influence. Ghosh and De (2004) in their paper investigated the role of various infrastructure facilities in determining the level of economic development across Indian states. Swaminathan (2009) adopted Biehl's methodology to arrive at a measure of infrastructure index and using a modified Cobb-Doughlas production function with infrastructure investment as an input in production. The results showed that the dispersion in social infrastructure was the maximum (0.28) followed by economic (0.21) and general infrastructure (0.17)

thereby underlining the importance of social infrastructure in achieving/hindering inclusive growth in the Maharashtra economy. Using fixed effects model with introduction of agroclimate and time interactions, Binswanger et al (1999) found that except for irrigation, all other infrastructure variables influenced aggregate crop output positively. Fan et al (1999) used a simultaneous equations model and showed that government spending on productivity-enhancing investments and rural infrastructure, directly resulted in reducing rural poverty, and indirectly resulted in agricultural productivity growth. Thus, various studies both at the international level and in the Indian context (Spencer, 1994; Kurian, 2001, Chand, 2001; Thorat et al, 2003; Modi, 2005) pointed out the importance of economic infrastructure to boost productivity in agriculture and as a strategy for rural development. The role of transport (Spencer, 1994; Binswanger et al, 1989; Felloni et al, 2001; Thorat et al, 2003; Rajeev, 2008), irrigation and electricity (Barnes and Binswanger, 1986, Felloni et al, 2001; Thorat et al, 2003; Modi, 2005) in augmenting agricultural productivity have been highlighted in literature. After a brief outline of the research studies, it is clear that most studies analyse the availability of infrastructure in examining its linkage with agriculture. Studies that examine the linkages between agricultural productivity and infrastructures have mainly stressed on the importance of provisioning of infrastructures. The present study seeks to establish that mere creation of infrastructures in rural areas will not influence improvements to agricultural productivity. Utilisation of these infrastructure stocks is imperative to achieve the desired levels of development. How utilisation of rural infrastructure can influence agricultural development has not been accounted for explaining differences in productivity in existing literature. The main contribution of this paper lies in empirically assessing the importance of utilisation of the existing infrastructure to achieve the desirable goals, along with the availability of infrastructures. Analysing the relationship between infrastructure and agriculture needs to go beyond a macro analysis. The regional characteristics, agro-climatic variability, governmental policies are so varied that 4 an analysis at the sub-national level would be useful to understand the contribution of infrastructure to agricultural development in a specific context. In this regard, the present study attempts to empirically examine the impact of rural infrastructure on agricultural productivity at the district level for three decades.

Data and Methodology

Data Sources Data on agricultural and rural infrastructural development indicators were collected and compiled from various secondary sources. Most of the data on agricultural development indicators were collected from the Statistical Abstract of Karnataka, Karnataka at a Glance, Quinquennial Livestock Census, District Statistical Hand Books, Human Development Reports and Karnataka Development Report. Data on infrastructure development indicators were collected from various sources such as the Statistical Abstract of Karnataka, Population Census, Reports of Karnataka Food and Civil Supplies Corporation, Departments of Co-operation and Rural Development and some unpublished documents of Directorate of Economics and Statistics.

Methodology

In order to construct indices of rural infrastructure, the study adopted the method of Principal Component Analysis (PCA) to combine the developmental indicators into composite indices. PCA is a widely used method where it helps in explaining the variation of the observed variables based on a set of dimensions. Many studies have used PCA to construct developmental indices (Venkataramanan et al, 1985; Gayathri, 1997; De and Ghosh, 2005; De, 2010). The correlated original variables are transformed into a new set of uncorrelated variables using the correlation matrix. This statistical technique linearly transforms an original set of variables into a substantially smaller set of uncorrelated variables that explain most of the information in the original set of variables.

The PCA technique takes N variables x1,x2 ,..xN and finds linear combinations of these to produce principal components Z1 ,Z2 ,...ZN that are uncorrelated.

This can be presented in the following form: Z1=a11x1 + a12 x2 +… +a1N xN Z2=a21x1 + a22 x2 +… +a2N xN … ZN=aN1x1 + aN2 x2 +… +aNN xN (1) PCA uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables called principal components. There are N principal components i.e. the same as the number of variables. The Z1 or the first Principal Component is constructed as Z1 = a11 x1 + a12 x2 +… a1N xN. PCA consists of finding the Eigen values λj of the correlation matrix. The correlation coefficients between the principal components Z and the variables x are called component loadings, r (Z, x) j i. Finally, the factor loadings for the first Principal Component Z1 are obtained by dividing each column (or row) sum by the square root of the grand total. The factor loadings thus obtained are the correlation coefficients of the respective indicator with the composite index. The weights are applied to all the variables xj in Equation (1) to satisfy the conditions of being

uncorrelated and that the first component accounts for the maximum possible proportion of the variance of the set of x s. In order to rule out a single variable to have its influence on the factor loadings, the variables were standardized based on geographical area or population and then linearised to remove the scale effects. The variables of infrastructure availability and utilisation used to construct the developmental indices are given in Table 1. For estimating the relationship between rural infrastructure and agricultural productivity, we used a large panel set using random effects in which agricultural productivity is a function of infrastructure indices, human capital and natural resource factor. The data set is a balanced panel of 19 districts for the thirty-year period in the state of Karnataka.

Sources of Data and Variable Descriptions

This paper is based on secondary data. The Employment and Unemployment Surveys (EUS) of the National Sample Survey Organization (NSSO) conducted during 2004–2005 (61st round) and 2011–2012 (68th round) and the annual Periodic Labour Force Survey (PLFS) conducted during 2018–2019 are used. For estimating employment status of individuals, their Usual Principal and Subsidiary Status (UPSS) is considered. To obtain the absolute number of workers, the Census projected population for the survey specific years are adjusted with the NSS estimates. For calculating sub-sectoral employment, the National Industrial Classification (NIC) Codes (with due concordances for the years 1998 and 2008) are used. The National Occupational Code (NCO) 2004 is used to find out the occupations in which individuals are engaged during the surveys. Individual-level information including: age, sex, level of education (within general education), type of education (general, technical, or vocational), marital status, sector of employment, occupations, and earnings, is obtained from the unit-level data of EUS and PLFS data. These surveys also provide the family-level information like: family size, social group, religion, monthly household expenditure, etc., while both individual- and family-level information is used as control variables and instruments in the micro-level estimation of determinants of poverty and non-farm employment. The percentage of people living below the poverty line (BPL) is estimated using the monthly per capita household expenditure (MPCE).

Moreover, the macro-level variables (collected at the state level from the "Handbook of Statistics on Indian States"—Reserve Bank of India (RBI)) including: Net State Domestic Product (NSDP) for the non-farm sector, Gross Fixed Capital Formation (GFCF) as a proxy for investment, dependency ratio (ratio of elderly (60 years and above) and children (below 15 years) to total population), number of factories/industries, number of branches of Scheduled Commercial Banks, length of states roads (in KMs), length of highways (in KMs), length of railways routes (in KMs), number of schools (Govt. and Private), etc., are used as control variables in the macro-level estimation.

Government's Initiatives

India has been well endowed with natural, physical and biological resources, such as land, water, labor, livestock, fisheries, forestry, vegetation, climate, solar, wind energy etc. With the aid of science, technology and capital the country has not exploited even 25% of its potential for agricultural development. Agriculture, apart from providing livelihood and food security, has tremendous potential to fuel country‟s economic growth and has maximum cascading impact on the development of secondary and tertiary sectors in rural areas. With a view to developing agriculture, after independence, the Government of India over a period of time created following organizational, institutional and physical infrastructure. Community development blocks and national extension service; rural financial institutions, panchayati raj [local bodies] institutions; district rural development agencies; district industries centers, national rural road development agency; khadi & village industries commission/boards; sericulture/ coir/handloom/handicraft boards; rural electrification corporation; central water commission and groundwater boards; Agricultural research, extension and education institutes; farmers training centers and kishi vigyan kendras [Agricultural Science Centers]; Seeds, fertilizers, pesticides and farm machinery manufacturing units; developing irrigation potential, Processing, preservation, storage, roads, transport and marketing facilities Government of India‟s effort more particularly since 1969 to create extensive banking infrastructure, comprising 13,500 branches of District central cooperative banks supported by 109,924 Primary Agricultural Credit Societies at village level, 31,645 and 3,751 rural and semi-urban branches of 27 public and 22 private sector banks respectively and 14,500 branches of 96 regional rural banks, facilitated rural households easy and reliable access to agricultural credit and helped them raise country‟s farm output. Provision of credit by banks for production, processing, storage, transport and marketing including export trade has inspired farmers with medium and large-holdings to mechanize, commercialize and modernize agriculture.

On Estimating Poverty

The Poverty Head Count Ratio (PHCR) or the percentage of people living below the poverty line (BPL) is estimated using the monthly per capita household expenditure (MPCE) information using from the EUS and

PLFS data, instead of the Consumption Expenditure Survey (CES). This is done because it enables us to compute PHCR by sector of employment (farm and non-farm sectors) of the individuals, which is not possible through the use of CES data. Although the recent CES survey conducted by NSSO (during 2017–2018) could have been used for the aggregate (macro-level modelling)-level analysis, had it been available in the public domain.

For estimating PHCR, the Tendulkar poverty line is used (see Table 1). The minimum threshold MPCE level as computed by the Planning Commission (for the years 2004–2005 and 2011–2012) is utilized. Moreover, the threshold poverty line for the year 2018–2019 is calculated with due adjustment of the 2011–2012 poverty line with the "Consumer Price Index (CPI) of the Rural Labour for the year 2018–2019" (see Table 1).

Conclusion and Policy Implications

In spite of several efforts and interventions by the government departments, national and international development agencies and civil societies, the rural poverty continues to persist in India. The study has clearly brought out the importance of agricultural productivity, farm wages, and rural literacy. The continuing primacy of agriculture as the primary source of employment, particularly in the Indian rural economy calls for considerable improvement in agricultural productivity. For increasing agricultural production and accelerating productivity, especially the total factor productivity (TFP), the need for raising public investment is well documented.

There is an urgent need for substantial increase in public investments in irrigation, rural infrastructure (roads and power), research and development, etc. Further, the spread of agricultural growth to less-developed regions would lead to an increase in the overall agricultural growth as well as a reduction in the rural poverty in the country. Policy measures like land reforms, enhanced rural credit, and greater public investment are the important instruments to promote agricultural growth in less developed regions. The level of literacy has turned out to be one of the most significant determinants of rural poverty. The higher level of illiteracy and lack of skills among the majority of rural people are serious constraints to their socioeconomic development and are acting as barriers for accelerated reduction in poverty.

Considering the importance that agricultural sector holds for Karnataka economy, the present paper assesses the relationship between agricultural productivity and infrastructure development across the districts of Karnataka. The foregoing analysis provides insights into understanding the main drivers of agricultural productivity in Karnataka using land productivity as the dependent variable. In order to examine the relationship between rural infrastructure and agricultural productivity, the paper focused on different classifications of rural infrastructure and estimated the influences of infrastructure on agricultural productivity using district level data for the period between 1980 and 2010 in Karnataka. In contrast to the earlier studies, the present analysis develops infrastructure availability and utilisation indices to examine the impact of rural infrastructure on agricultural productivity. We employed a random effects model to estimate the relationship between rural infrastructure and agriculture using a panel of 19 cross-section units spanning over 30 years. The random effect estimations showed the importance of rural infrastructure in boosting agricultural productivity. The study emphasises the role of making the infrastructures available in rural areas as significantly contributing to agricultural productivity. Infrastructure utilisation index has turned out to be significant and positive, indicating that utilisation of infrastructure can also influence productivity in agriculture positively. Also, more developed districts have better infrastructure facilities while the lagging regions are inadequate both in terms of infrastructure availability and utilisation. Along with infrastructures, the use of traditional inputs such as fertiliser application and the mechanisation of agriculture as indicated by tractor use are also responsible for significant differences in land productivity across the districts. There is a need to introduce new infrastructures and efficient use of existing ones in rural areas. Resolving regional disparities does not call for equalising provisions of every infrastructure, but provision of those that are region specific. Improvements in institutional mechanisms can go a long way in improving agricultural productivity. Utilisation infrastructure index of economic indicators turns out to be a positive determinant of agricultural productivity. Optimal utilisation of existing infrastructure is a result of a combination of factors. Utilisation of some infrastructure is conditional on the availability and quality of other infrastructure and it is possible that the lowest common denominator determines the overall utilisation of infrastructure. Thus, rural infrastructure affects agricultural productivity directly through improvements in infrastructures. Therefore, assessing the importance of utilisation of the infrastructure brings to fore several key points that may be ignored if focus remains only on addition to the stock of infrastructure. Further, strengthening human capital and augmenting information awareness enables better usage of existing structures. Thus, the study throws up evidence in support of greater investment in infrastructures in rural areas while at the same time calling for steps to be taken to maximise the utilisation of existing resources.

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