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Rural infrastructure and agricultural growth linkages in Jammu and Kashmir

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ABSTRACT

An attempt has been made in this study to analyze the growth and impact of rural infrastructure on agricultural land/labour productivity in Jammu and Kashmir employing secondary data. The results indicated that although the road network in the state has significantly expanded but still number of regions are yet to be connected. Similarly 3% of the villages are yet to have electricity facility though the proportion of village electrified has increased since 1980s'. Moreover it is interesting to note that the electricity consumed for agricultural activities constitute only 5% of total electricity consumption in the state. As far as irrigation capacities in the state are concerned, it has shown only a marginal improvement over the years. While cooperative have shown a decline, the branches offices of banks have increased significantly. The estimates of agricultural land/labour productivity models revealed that rural infrastructure variables have significantly contributed to the growth of agricultural productivity and may have significant marginal impact. On the basis of major findings, this study suggests that the pace of growth in development of the agricultural economy has to be accompanied by consistent growth in rural infrastructure. The study also advocated the public-private partnership in building basic rural infrastructure uniformly across the state.

Keywords: Rural infrastructure, agricultural productivity, linkages

The creation of rural infrastructure is essential for agricultural development which is pertinent for economic growth. Considering its important role in economic development, rural infrastructure has been an important theme of scholars at national/ international level (Hirachman, 1958, De vries, 1960, Nicholls, 1963, Ishikawa, 1967, Youngson, 1967, World Bank, 1994). The infrastructure is considered pre-requisite for take-off and for attracting various economic activities. It was recognized that, unless being well served by infrastructure, no business would benefit from these activities (Munnell, 1990). The linkages between infrastructure development and sustained output growth have been highlighted by many global studies as well (Aschauer, 1989, Canning, 1998, Calderon and Chong, 2004, Sawada, 2000, ADB et al., 2005, Estache et al., 2005 Pinstrup-Andersen and Shimokawa, 2006). Yet plethora of studies brought out that rural infrastructure (both physical and institutional) together plays a key role in determining the agricultural output in particular (Antle, 1983, 1984, Datta and Ravallion, 1998). Not only this, cumulative effects of infrastructure accentuate the process of commercialization in agriculture and rural sector (Jaffee and Morgan, 1995). Accordingly government spending on rural infrastructure has significant impact on agricultural growth and rural poverty (Fan et al., 2000, Baba et al., 2010a, Baba et al., 2010b).

Varying levels of rural infrastructure and policy environment coupled with varied agro- climatic

conditions and resource endowment determine differential growth performance of agriculture across states/regions. Jammu & Kashmir (J&K), a western Himalayan state has a unique agro-climatic setting and it is presumed that various efforts for raising agricultural land/labour productivity in this state may be hampered to a great extent by various mountain specificities that hinders development of essential rural infrastructure. This background emphasized upon a comprehensive investigation of existing stock of infrastructure and its role in agricultural productivity in Jammu and Kashmir state of India in broader policy perspective.

Materials and Methods

An attempt has been made in this paper to study growth of important infrastructure variables and their impact on agricultural land/labour productivity in Jammu & Kashmir (J&K), a north-western Himalayan state. The present study is based on the secondary data collected from various published/ unpublished records of government of J&K. The five infrastructure parameters were taken in the study viz road, villages electrification, financial institutions, irrigation and agricultural cooperatives. The study examines the stock and progress of different rural infrastructure variables in the state followed by the impact analysis of infrastructure.

The model: Structural Form and Hypothesis

Regression model of following structural forms, have been developed to analyze the impact of various infrastructural variables on agricultural land/labour productivity:

Agricultural labour productivity model

AWP = f(LAW, TRC, FERT, IR, SROAD, UNSROAD, COOP, LIT, CI, LVSW, U) ---------- (I)

Agricultural land productivity model

ALP = f(WAL, TRC, FERT, IR, SROAD, UNSROAD, VELE, BNK, LVSL, CI, RAIN, U) --- (II)

where,

AWP = Agricultural labour productivity (value of agricultural production (AGDP)/active population in agriculture (₹/agri. labour))

ALP = Agricultural land productivity (value of agricultural production (AGDP) /agricultural land (₹/ha))

WAL = Agricultural workers/agricultural land (no./ha)

LAW = Agricultural land per agricultural worker (ha/worker)

TRC = Tractors per thousand hectares of net sown area

FERT = Fertilizer consumption (kg/ha of total cropped area)

IR = Irrigated area as per cent of total cropped area (%)

SROAD = Density of mettled/surfaced road (km/00sqkm of geographical area)

UNSROAD = Density of un-mettled/un-surfaced road (km/00sqkm of geo. area)

COOP = Density of agricultural cooperatives (no./000' of agri. workers)

LIT = Literacy rate (%)

RAIN = Rainfall (mm)

BNK = Density of bank offices (no./ten thousand hectares of net sown area)

VELE = Villages electrified (%)

CI = Cropping intensity (%)

LVSL = Livestock density (no./hectare of net sown area)

LVSW = Livestock density (no./hectare agricultural worker)

U = Error term

Productivity provides a better analytical and empirical framework for studying the effect of the stock of physical infrastructure in the agricultural sector, therefore, agricultural land/labour productivity has been specified as endogenous variable in equation I and II. Moreover, by considering agricultural land/labour productivity rather than production, various errors of estimation seem to be extracted out. The explanatory variables are divided into two categories: (1) agricultural input variables like tractor per thousand hectares of net sown area, fertilizer consumption per hectare of total cropped

area, agricultural land per agricultural worker, agricultural workers per agricultural land, rural literacy, rainfall, cropping intensity and livestock density (2) infrastructure variables like road density, percentage cropped area that is irrigated, density of cooperatives, rural electrification, and density of bank branches. Though various explanatory variables were specified in the structural form of the models but only those variables that gave the best fit to the function without affecting the individual regression coefficients were kept in final form of the model. The model was estimated in log-linear form employing OLS procedure confirming a hypothesis that every infrastructure variable may have the positive impact on both agricultural labour and land productivity. Besides, in order to find out the effect of an additional unit of infrastructure on agricultural land/labour productivity marginal impact were estimated by using relevant regression coefficient and mean values of respective exogenous and endogenous variables.

Result and Discussion

Major proportions of state's population reside in rural areas and rely directly or indirectly on the agricultural sector despite its declining share in state income over the years. The relative contribution of agriculture to overall economic growth decreased as economy develops in the state, however, its development still provides a crucial foundation for growth in both agricultural and non-agricultural sectors in view of its contribution towards labour employment. In view of important role of agricultural sector in the development of rural community, emphasis should be on strengthening of both backward as well as forward linkages of agricultural economy that can be made possible by building basic rural infrastructure. We now turn to the existing evidence about the growth and current stock of rural infrastructure in J&K.

Road Infrastructure

The transportation facilities are regarded as the arteries of mainstream development and a prerequisite for development of modern marketing system. In agriculture, road investment can increases intensity of land use (Ahmed and Hossain, 1990), use of fertiliser (Badatya and Nair, 2004), aggregate crop output (Binswanger et al., 1987, 1989; Ruttan, 2002, Mundlak et al., 2004) and can prevent loss of crops between farm gate and consumers (World Bank, 1997). Investment in roads reduces rural poverty through productivity growth and also through increased non-agricultural employment opportunities and higher wages (Fan et al., 2000). Road infrastructure has yet more importance in hilly states where it helps in increasing accessibility to non-farm jobs (Baba et al., 2010a). The growth pattern of road length and its density in J&K are presented in the Table 1. The annual growth in road length was estimated at 2.49% in J&K. Increasing road density is a positive sign towards the economic development of the state. Quality roads have also increased over the years as indicated by the expansion of surfaced road that constituted more than 86% of total road length in the state during 2010-11. The density of surfaced road has also increased significantly in the state. Although road density has shown a favourable increase but the state require huge investment for the uniform development of roads across the districts/ regions which being inaccessible and restrict the exploitation of niches in the areas which otherwise could push growth in agriculture much beyond predictions. There is also a need to lay new railway tracks improve inter-district/state connectivity that would in turn improve existing marketing system in the state to the advantage of the growers by reducing transportation cost, a major components in marketing of the horticultural produce in the state.

Table 1. Road infrastructure in Jammu and Kashmir

Year	% of total		Total length Kms	Density**		
	S	US		S	US	Total
1980-81	68.54	31.46	8206	23.28	10.69	33.97
1990-91	79.23	20.77	11838	38.82	10.18	49.00
2000-01	82.98	17.02	13660	46.92	9.62	56.54
2010-11	86.11	13.89	21819	77.77	12.55	90.31
CGR (%)	3.27*	-0.41*	2.49*	3.27*	-0.41*	2.48*
	(0.19)	(0.21)	(0.14)	(0.19)	(0.22)	(0.14)

S= Surfaced road, US = Un-surfaced road **km/00km-1 of geographical area

Figures within parentheses indicate standard errors

**Significant at 5% or better probability level

Electricity Infrastructure

Rural electrification is an important basic infrastructure essential for agricultural modernization as it leads to the adoption of several advanced technologies. Consistent with this studies have observed that rural electrification increases use of pump sets to harness underground water for crop cultivation because of its better reliability and controllability (Barnes and Binswanger, 1986, Dhawan, 1988, Vaidyanathan et al., 1994, Shah et al., 2006). Accordingly growth of rural electrification has been analyzed in J&K. As documented in Table 2 only 55% villages were electrified during 1980-81 in J&K, but later up to early 2000's electricity was supplied to more and more villages at an annual growth rate of over 1.40 percent. J&K in this regard still have a dubious distinction as still 3% of villages are not electrified in J&K. The distinction further widens if we consider the duration of electricity supply in the connected villages in the state. Moreover, electrification of villages doesn't mean that electricity is used for agricultural operations; hence, it is equally important to examine the extent of consumption of electricity for agriculture purposes. The electricity consumed for agricultural operations revealed that it increased significantly over the years in the state, and its consumption has reached to 198 kWh/ ha of TCA in this state. This pattern of electricity consumption emphasized upon energizing more pump sets for improving water use efficiency under hilly terrains of these state.

Table 2. Village electrification in Jammu and Kashmir

Year	Village electrification (%)	Electricity consumed in agriculture (kWh/ha of TCA)
1980	55.42	23.92 (5.54)
1990	93.24	124.73 (10.13)
2000	95.83	113.46 (4.77)
2010	96.89	198.10(4.90)
CGR (%)	1.40*	6.91*
	(0.21)$	(1.35) $

Figures within parentheses indicate consumption of electricity in agriculture as percent of total consumption

*Significant at 5% or better probability level and $ indicate standard error

Irrigation Infrastructure

Irrigation water is one of the critical inputs required for better performance of crops. Irrigation infrastructure increases the land use/cropping intensity, provides incentives for use of more inputs, and thus results in higher agricultural output (Dhawan, 1988, Shah, 1993, Vaidyanathan, 1999, Narayanamoorthy and Deshpande, 2005 Wani, et al., 2009, Baba, 2006). It is clear from Table 4 that there has been a marginal expansion (1.3%) of the irrigation infrastructure across the state between 1980-81 and 2010-11. Regarding sources of irrigation government irrigation source (canals) constituted around 90% of net irrigated area in J&K though other sources of irrigation are gradually gaining importance. Location specific technological advancement for harnessing available water for agricultural purposes would help in improving agricultural intensification.

Table 4. Irrigation capacities in Jammu and Kashmir (Percent)

Year	Canal	Tank	Well	Other	Total**	%
1980-81	93.75	0.66	1.32	4.28	304	42.52
1990-91	93.45	0.66	0.45	5.43	298	40.78
2000-01	91.40	0.87	0.49	7.23	311	41.56
2010-11	89.97	1.94	3.63	4.45	321	43.82
CGR (%)	-0.05*	1.36*	-3.04*	1.37*	0.06	0.09
	(0.02)	(0.41)	(0.49)	(0.34)	(0.04)	(0.05)

Figures within parentheses indicate standard errors

**Area in 000ha. *Significant at 5% or better significance level

Stagnation of irrigation capacities coupled with frequent advent of drought hampered productivity gains that may otherwise accrue due to the adoption of water-intensive technologies. Although, the state have abundant surface water in the form of perennial rivers, but irrigation network has not a desirable spread. The endowment of water resources could be tapped for productive utilization in agriculture by effective means. Water harvesting structure to harvest run-off and rainwater to be used for agriculture purposes would be an important activity to be encouraged.

Cooperatives and Institutions

Besides, there are other supplementary infrastructure variables like cooperatives and financial institutions that improve agricultural productivity/marketing efficiency. Better access to institutional infrastructure plays a pivotal role in the growth of agricultural sector (Binswanger et al., 1993; Ramachandran and Swaminathan, 2002). In this context, the data were also analysed with respect to subsidiary infrastructures like coverage of bank branches and agricultural cooperatives in the state. Perusal of Table 7 revealed that the absolute number of cooperative has declined from 1634 (1980-81) to 1127 (2010-11) at an annual growth of 2.67 per cent. In consonance with this, density of cooperative has shown a declining trend in the state. The decline of agricultural cooperatives coupled with emergence of marginal/small farmers and declining surpluses is really a cause of concern for agricultural planner and voluntary agencies though, the unprecedented decline of cooperatives need to be curbed by imparting more professionalism in the existing cooperatives and new to be encouraged. On the other hand, branches of financial institutions grew at 2.21% annually in the state. Only eight branches are available for one lakh persons in J&K. The density of bank branches with respect to cultivated area have increased that could partly be owing to the decline of the area under cultivation in the state.

Table 7. Agricultural cooperatives and institutions in Jammu and Kashmir

Year	Ag. Cooperatives			Bank offices		
	No.	Density$w.r.t		No.	Density$ w.r.t	
		Pop.	NSA		Pop.	NSA
1980-81	1634	28.14	228.53	387	6.67	54.13
1990-91	1276	16.74	174.56	746	9.79	102.51
2000-01	1011	10.20	135.16	809	8.16	108.15
2010-11	1127	9.16	154.04	1002	8.14	136.95
CGR	-2.67*	-5.27*	-2.61*	2.21*	-0.60*	1.92*
(%)	(0.25)	(0.22)	(0.22)	(0.31)	(0.20)	(0.25)

Figures within parentheses indicate standard errors

*Significant at 5% or better probability level and $ denotes density w.r.t. per lakh of population and net area sown

Model Estimates and Marginal Impact

An attempt has been made to quantify the contribution of various infrastructure variables on productivity of agricultural labour/land and results presented in Table 8. Model estimates revealed irrigation area, density of surfaced roads, literacy level and cropping intensity are positive significant determinants of productivity of agricultural labours. Irrigation facilities made it possible to use more labour intensive production technologies that engage more family/casual labours very efficiently. Similarly, cropping intensity turned a significant contributing variable of the labour productivity by way of efficiently employing labour in multiple cropping on existing cultivated area. The coefficients of surfaced roads clearly indicated the role of quality roads on the improvement of productivity. Quality roads helps transit of inputs/agriculture produces to and from the farm with the least damage and in turn improve productivity of agricultural labour. Education enlightens entrepreneur to take a rational decision and practice agriculture on more or less scientific lines and in this way could improve the labour productivity in state agriculture. Cooperatives have a major role not only in improving bargaining power of small/marginal farmers/marketing efficiency, but also help them to harness gains in input markets by strengthening backward linkages of the agricultural sector. However, negative but insignificant coefficients of agricultural cooperatives are in consonance with their declining trends in the state. The analysis emphasized the development of these societies for harnessing the potential of farming business by achieving various economies of scale particularly from bulk buying of inputs and selling of produce.

Estimates of land productivity model presented in Table (8) revealed that regression coefficient of density of bank offices appeared positive and significant, implying that coverage of banks have contributed to land productivity by extending farmers' access to capital to be spend on explicit variables. Intensification of agriculture would definitely result in improvement of output per unit of land per year. Multiple cropping of short duration crops in the state have improved cropping intensity that need to be augmented further in niche areas in view of their significant role in improving agricultural

land productivity. The model demonstrates that fertilizer consumption contributed significantly to improvement of agricultural productivity in the state. Agricultural workers per hectare of cropped area are another positive and significant determining factor of agricultural land productivity. In the state, agricultural diversification towards capital/labour intensive crop enterprises like vegetables, fruits, etc has taken place. These labour intensive crops not only created jobs for workers but contributed in improving land productivity. Electrification may help to energize the pump sets for improving water use/ inputs efficiency and in turn augment productivity of land under plough. The high adjusted R2 indicated the good fit of the model. Overall, the results showed that all infrastructural variables except few under study had the significant impact on the agricultural productivity in the state. The impact of infrastructure variables would be more visible when the volume of the business handled by them is considered.

Table 9: Impact of infrastructure on agricultural labour productivity in Jammu and Kashmir

Variables	AWP	ALP
CONST	7.37	19.32
LAW	3.27*(1.5)	-
WAL	-	4.27*(1.77)
TRC	2.51*(0.79)	0.36(0.42)
FERT	0.01(0.06)	0.18*(0.08)
IR	1.49*(0.6)	2.57*(1.22)
SROAD	0.61*(0.27)	2.09*(1.02)
UNROAD	-0.13(0.33)	0.72(0.4)
COOP	-0.62*(0.2)	-
LIT	1.62*(0.62)	-
VELE	-	0.17*(0.07)
LVSL	-	-2.13(2.39)
LVSW	3.83(2.04)	-
CI	1.16*(0.1)	-3.63*(2.43)
BNK	-	1.87*(0.25)
RAIN	-	-0.06(0.15)
R2	0.9911	0.9907

Figures within parentheses indicate standard errors

Significance at 5% or better probability level

The estimates of the marginal effect of significant infrastructure variables presented in Table 10 revealed an appreciable improvement in both agricultural land and labour productivity with unit increase in each of infrastructure variable. As documented in table, one per cent increase in irrigation capacity would increase productivity of each agricultural worker by 1373 rupees in this state. Similarly, such increase in irrigated area would increase land productivity by ₹ 2369. Surfaced road is yet another infrastructure variable that may improve agricultural productivity in the state. Marginal effect of literacy was also estimated in order to capture the impact of education infrastructures like schools and other institutions. It was observed that one per cent literacy increase in J&K would improve productivity by ₹ 1774 labour-. This scenario was in consonance with lower literacy rate in J&K compared to the national average.

Table 10: Marginal effect of infrastructure

Variable	AWP		ALP	
IR		1373		2369
SUR		585		2006
UNSUR		-		2798
LIT		1774		-
VEL		-		75
BNK		-		7268

Summary and Policy Options

Considering the fact that agricultural growth cannot be achieved in isolation without the development of rural infrastructure, an attempt was made in this paper to investigate the growth and influence of selected infrastructure variables on agricultural land/labour productivity in state. Five infrastructure variables namely road, irrigation, village electrification, institutions and cooperatives were examined in this study. The road length in the state has increased significantly in the state although the spread of surfaced roads was more pronounced. The study highlighted that only electricity consumed for agricultural operations constitute only 5% of total electricity consumption in the state. Further 3% of villages are still without this facility. The irrigation capacities in the state are almost stagnant as there has been only 1.3% expansion in irrigated area since 1980-81. The study has shown a deep concern about the declining trend of agricultural cooperative in view of increasing emergence of small/marginal farming category. On the other had branches of banks have

shown an appreciable increase over the years. The estimates of agricultural land/labour productivity models revealed that rural infrastructure variables have significantly contributed to the growth of agricultural productivity, in addition infrastructure variables showed significant marginal impact on agricultural productivity. Following policy suggestion emerge on the basis of findings:

- In view of the firm relationship between rural infrastructure and level of agricultural productivity, there is significant scope for increasing the output from agriculture in the state by improving the rural infrastructure. Further, the relation between infrastructure and agricultural development is not a onetime phenomenon, but a continuous process. The pace of growth in development of agricultural economy has to be accompanied with the growth in rural infrastructure in order to place the development process on self-accelerating trajectory.
- The irrigation capacities should be expanded in view of their crucial role in the improvement of agricultural productivity. Although mega-irrigation projects require a long lead time to become productive, low gestation micro-irrigation project like water harvesting structures, lift system of irrigation, etc should be funded to have an immediate effect by extending coverage of irrigated area. In addition, existing irrigation structures should be made functional by removing obstructions and through regular maintenance.
- Since the pattern of development of important infrastructure has not been uniform in the state that needs to be given due consideration. The cooperative societies should be revitalized to increase the bargaining strength of growers. There is a need to inculcate more professionalism among different stakeholders and skilled management in cooperative organizations.
- The expansion of physical infrastructure requires adequate capital infusion and hence this component should be placed among new priorities in upcoming economic planning. The public sector may not be able to make the investment to the desired level in the state; the private sector should be encouraged to enter into this venture. The priority allocation of resources in the development of these rural infrastructures through public-private partnership would yield substantial returns in the long-term. For this reason, the public-private partnership is necessary where subsidies or incentives provided by the government would help to attract private investment towards the disadvantaged areas. However, because of the public goods nature of infrastructure, most of the investments needed must come from the public sector as a pump primer.

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