

Role of Rural Infrastructure in Agricultural Growth in Punjab

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Abstract

Rural infrastructure is absolutely essential to agriculture's strength, which sets the pace for our nation's economic development. Despite being a small state (1.54 percent of the country's total size), Punjab produces a significant amount of foodgrains, particularly wheat and paddy for the central market. The well-known "Green Revolution", the adoption of high-quality seeds, and the expansion of agri-infrastructure in the Punjabi state have all been directly linked to the growth of agricultural sector. This study examines the connection between agricultural infrastructure and agricultural productivity in Punjab during the period 1991 to 2022. The data reveals that the rural infrastructure has contributed significantly in improving agricultural growth in Punjab.

Keyword: Agriculture Growth, Productivity, Rural Infrastructure

Introduction

The strength of Punjab's agriculture sector, which drives economic growth, depends only on the state of the rural infrastructure. The progress of agriculture achieved in Punjab has been achieved directly with the concerted efforts in rural infrastructure investment like markets, electricity, irrigation, banks, roads and so forth. The World Development Report (1994) highlighted the relationship between the level of GDP and infrastructure stock. Infrastructure increases the productivity and lowers the unit cost in the production activities of the economy. The pay off from good infrastructure services go beyond declining the technical inefficiencies and financial losses (Gowda and Mamatha 1997). The adequacy of infrastructure helps to determine the success or failure in agriculture in terms of level of production and diversifying the sectors. No doubt, the concrete linkage between infrastructure and development is a continual burning debate, but, the experiences across the world have witnessed the rise in stock of infrastructure associated with the rise in output across the countries. As the countries flourish, infrastructure must adapt to support the variations in demand as the share of the power, roads, telecommunication in the total stock of infrastructure strengthens relative to the basic services such as irrigation, etc. There are number of studies which have dealt directly with the infrastructure and economic growth. Barnes and Binswanger (1986), Elhance and Lakshmanan (1988), Binawanger et al (1989), Datt and Ravallson (1998) and Sahoo and Saxena (1999) deal more directly with infrastructure and income as rural infrastructure plays a vital role in enhancing the agricultural productivity and reducing poverty in a state and a country as whole. However, depending upon the nature of services delivered, infrastructure can be broadly divided into different categories as physical and social both of which are all economically desirable. Apart from these, there are institutional and financial infrastructure

that have paramount role in agrarian development and agricultural productivity growth that includes number of regulated market, total storage capacities, and rural credit as reflected by intensity of rural commercial banks as well as cooperative banks. The economy may not be able to reach its full growth potential due to high transaction costs caused by inadequate and inefficient infrastructure. As a result, infrastructure facilities in the form of social overhead capital help to support economic growth and development across all sectors. The relationship between infrastructure and development is not a fixed idea but rather an ongoing and continual process Kumar and Singh (2006). The expansion of physical infrastructure requires immense and continuous investment, and hence, its availability in various states depends upon the relative priority accorded by the state government.

Objectives

Most of the earlier studies have been at the national or state level, and obviously consider the variations in the homogenous units. Further detailed study is required to look at the various indicators of rural infrastructure in the state of Punjab and its effect on agricultural productivity. The primary objectives of the study are as below:

- To examine the relationship between rural infrastructure availability and the development in the state of Punjab.
- To analyse various issues in the growth of rural infrastructure.

Database and Methodology

The study is based on secondary data sources to examine the impact of rural infrastructure on the agriculture progress in the state of Punjab from 1990-91 to 2020-21. The data on area, production and yield of major crops food crops (rice and wheat) and commercial crops (Cotton and sugarcane) are obtained from Handbook of Statistics on Indian States, RBI (2021-22) and Economic survey, GOI (2021-22). The data on rural infrastructure such as the number of tube wells, Gross irrigated area, number of regulated markets, state owned storage capacity, regional rural banks are taken from various issues of Statistical Abstract of Punjab, RBI handbook of statistics, Economic Survey of Punjab, Dept of agriculture Punjab, Rural health statistics, GOI.

Nature of Punjab Economy

Punjab has occupied the position of the most advanced state in agricultural development owing to the advent of green revolution. Overtime, though agricultural sector experienced a decline in the importance in terms of its share in GSDP, yet it remains the single major important sector of the state economy. Economic activities in Punjab have showed structural changes over the period of time. Overall the economy of Punjab state has witnessed a growth rate at constant prices of 3.93, 6.52, and 6.08 for the period 2000-01, 2010-11, and 2020-21 respectively. Table 1 shows that as per the advanced estimates of 2020-21, the GSDP of the state has showed the amount of Rs. 412668 cr (at constant prices) observing an increase over GSDP of 2011 which was Rs. 266628 cr (at constant prices). It depicts that the GSDP has increased by 54.77 percent between these two periods. The NSDP of the Punjab has also increased by 23.27 percent during the period 2011-2021. It is notable that the Per Capita income at constant prices was Rs.85577 in 2011 which has increased to Rs. 112119 in 2021. At current prices, the GSDP has increased by 99.73 percent during the period 2011-2021. Thus, as compare to the year 2011, NSVA as

well as PCY have increased by 96.91 percent and 75.15 percent respectively in the 2021 shown in table 2.

Punjab is predominantly an agrarian state and has been contributed a substantial share in Gross Domestic Product. It is observed that the share of GSDP of Punjab in GDP of India has slightly declined by 0.27 percent in the period 2021 in comparison with 2011 (Table 3). The recent declining trend of its share has started from period 2014-15 when it was reached to 2.96 in comparison with 2013-14. This indicates that rest of India is growing faster than Punjab in the recent period.

Table 1: Overall Gross State Domestic Product, Gross State Value Added and Per Capita Income at constant prices for 2011 and 2021 (In crore)

	2011	2021	% change
Gross State Domestic Product	266628	412668	54.77%
Net State Domestic Product	239226	294894	23.27%
Per Capita Income	85577	112119	31.01%

Source: Statistical Abstract, Punjab (Various Issues)

Table 2: Overall Gross State Domestic Product, Gross State Value Added and Per Capita Income at current prices for 2011 and 2021 (In crore)

	2011	2021	%change
Gross State Domestic Product	266628	532555	99.73%
Net State Domestic Product	239226	471073	96.91%
Per Capita Income	85577	149894	75.15%

Source: Statistical Abstract, Punjab (Various Issues)

Table 3: Share of GSDP of Punjab in GDP of India

Year	GDP of India Rs. (in crore)	GSDP of Punjab Rs. (in crore)	% share of Punjab in GDP of India	% share of Punjab in population of India
2011	8301235	266628	3.21	2.29
2021	13558473	399780	2.94	2.30

Source: Statistical Abstract, Punjab (Various Issues)

The sectoral distribution of Gross State Domestic product and Gross state value added of Punjab state at constant prices revealed that both has experienced a rising trend by 54.77 and 48.00 percent respectively during the period 2011-12 to 2020-21. At constant prices, the contribution of primary sector consisting of agriculture and allied activities toward GSVA has decreased by 6.35 percent point in 2021-22 in comparison with 2011-12. It has observed that the share of agriculture sector in the GSVA has declined from 30.81 to 24.47 in the period 2020-21. The rest of the secondary and tertiary sectors have experienced an increment in GSVA. Table 4 shows growth and sectoral distribution of GSDP and GSVA during 2011-12 to 2020-21.

Table 4: Estimates of GSVA at Constant (2011-12) Prices (in lakh)

Sn.	Industry	2011-12	2020-21	% change
1	Primary	7820507 (30.81)	9187786 (24.47)	17.48
1.1	Agriculture, forestry and fishing	7816825 (30.80)	9181631 (24.45)	17.45
1.2	Crops	5007937 (19.73)	5217380 (13.89)	4.18
1.3	Livestock	2034580 (8.02)	3080633 (8.20)	51.41
1.4	Forestry and logging	715707 (2.82)	790911 (2.11)	10.50
1.5	Fishing	58601 (0.23)	92707 (0.25)	58.20
1.6	Mining and quarrying	3682 (0.01)	6155 (0.02)	67.16
2	Secondary	6444054 (25.40)	9258287 (24.66)	43.67
3	Tertiary	11112868 (43.79)	19114444 (50.87)	72.00
4	GSVA	25377429	37560517	48.00
5	GSDP (at Market Prices)	26662829	41266824	54.77

Source: Statistical Abstract, Punjab (Various Issues)

Growth of Rural Infrastructure

As a base and concomitant of the agricultural development process, rural infrastructure must be fairly well organised in a particular state. Being the Punjab as agrarian state, the rural development is quite prominent for agricultural productivity growth and overall growth of the state. Punjab state had made remarkable progress in agriculture by taking a big leap forward in terms of irrigation facilities, use of chemical fertilizers, pesticides, mechanization etc. Backed with effective agricultural policies, the farmers started to take into consideration the advice of the experts through well established agriculture extension networks and achieved the record productivity levels. Major infrastructural drivers of state agricultural growth are presented in the table 5.

Table 5: Rural Infrastructure in Punjab (1990-91 to 2020-21)

	1990-91	2000-2001	2010-11	2020-21
TUBEWELLS AND WELLS (000 ha)	2233	3074	2954	2894
GROSS IRRIGATED AREA(1000 ha)	7054.8	7663.8	7723.8	7739
% of GROSS IRRIGATED AREA to GROSS CROPPED AREA	94	98	98.3	98.9
NUMBER OF REGULATED MARKETS	143	144	146	154
STATE OWNED STORAGE CAPACITY (lakh tonnes)	117.63	251.59	226.33	226.18
REGIONAL RURAL BANKS	201	197	251	429
CONSUMPTION OF CHEMICAL FERTILISERS	1220	1313	1911	1896

(000 nutrients tonne)				
LENGTH OF ROADS(kms)	54261	60621	84193	147862
ELECTRICITY CONSUMERS IN AGRICULTURE	609551	794475	1143267	1385549
NUMBER OF PRIMARY HEALTH CARE CENTRES	460	484	449	427

Source: Statistical Abstract, Punjab (Various Issues), Handbook of Statistics on Indian States, RBI, Department of agriculture, GOP, Rural Health Statistics, GOP.

The number of tube wells which is one of the important components of irrigation, was 2233 per thousand hectares in 1990-91. Its number has been increasing continuously and has reached to 2894 per thousand hectares in 2020-21. In 1990-91, the area of 7054.8 (000 ha) was irrigated in Punjab which has risen to 7663.8 and 7723.8 (000 ha) in 2000-2001 and 2010-2011 respectively. In the current periods, the gross irrigated area has increased to 7739 (000 ha). Thereby, the percentage of gross irrigated area to gross cropped area has marginally increased from 94 in 1990-91 to 98.9 in 2020-21. Improvement in market infrastructure ensures better returns to farmers. Punjab Mandi Board, the coordinating body for market committee played the lead role in developing the village approach roads and market yards on priority to facilitate the efficient market and agricultural input delivery system in state. Indicators of market infrastructure presented in the table reveals that in 1990-91, the number of regulated markets in Punjab was only 143 but in the recent period 2016-17, its number has increased to 154 which has provided the new opportunities to farmers. The state owned storage capacity has also increased from 117.63 (lakh tonnes) in 1990-91 to 226.18 (lakh tonnes) in 2020-21. The road transport is vital to the progress of state economy. The total road length in Punjab during 2000-01 was 60621 km which was increased to 147862 km in 2020-21. The rapid dissemination and adoption of new technologies and modern inputs viz. HYV seeds, fertilizers, agricultural credit, development of necessary infrastructure and setting up of institutional mechanism create an enabling environment for enhancing the production in state. It can be observed from the table that during 1990-91, the number of Regional Rural Banks was 201. In 2000-01, its number remained only 197 but in the coming decade, with the setting up of new regional rural banks, its number increased to 251 and during 2020-21, the number has risen to 429. During 1990-91, the consumption of chemical fertilizers was only 1220 (000 nutrients tonnes) which has increased to 1896 (000 nutrient tonnes) in 2020-21. Energy is also vital necessity for the overall development of any state. Adequate and reliable availability of power is indispensable for sustained growth of the economy. The electricity consumers in agriculture during 1990-91 were 609551 which have increased to 1385549 in 2020-21. This has showed the rise in numbers of electricity consumers in the agricultural sector of Punjab. The primary health care centres in the rural areas are important for the health of the peasants. It has been observed that till the period of 2000-01, the primary health care centres has showed an upward trend but after this period it has started to decline and reached to 427 in 2020-21.

	1990-91 to 2000-2001 (% change)	2000-01 to 2010-11 (% change)	2010-11 to 2020-21 (% change)	1990-91 to 2020-21 (% change)
TUBEWELLS (1000 ha)	37.66	-3.90	-2.03	29.60
GROSS IRRIGATED AREA(1000 ha)	8.63	0.78	0.20	9.70
%GROSS IRRIGATED AREA/GROSS CROPPED AREA	4.26	0.31	0.61	5.21
NUMBER OF REGULATED MARKETS	0.70	1.39	5.48	7.69
STATE OWNED STORAGE CAPACITY (lakh tonnes)	113.88	-10.04	-0.07	92.28
REGIONAL RURAL BANKS	-1.99	27.41	70.92	113.43
CONSUMPTION OF CHEMICAL FERTILISERS (000 nutrients tonnes)	7.62	45.54	-0.78	55.41
LENGTH OF ROADS(kms)	11.72	38.88	75.62	172.50
ELECTRICITY CONSUMERS IN AGRICULTURE	30.34	43.90	21.19	127.31
NUMBER OF PRIMARY HEALTH CARE CENTRES	5.22	-7.23	-4.90	-7.17

Table 6: Growth of Rural Infrastructure in Punjab (1990-91 to 2020-21)

Source: Statistical Abstract, Punjab (Various Issues), Handbook of Statistics on Indian States, RBI, Department of agriculture, GOP and Rural Health Statistics, GOP.

The table 6 indicates the decadal percentage change in the various infrastructural components of agriculture since 1991. The results revealed that the number of regional rural banks has shown an exceptional growth since 1990-91 to 2000-01. This indicates that there was a commendable availability

of institutional credit to the farmers thereby reducing the cost of borrowing. This could increase the investment in production that can enhance the returns to the farmers. There was an overall 92.28% increase in the state owned storage capacities since 1991. The electricity consumers in agriculture have also shown a positive growth. However, the number of tube wells has increased by 29.60 percent from the period 1990-91 to 2020-21. This indicates that the dependence on tube wells has increased and farmers are still adopting traditional methods of irrigation instead of shifting to new methods of obtaining water. Consumption of fertilizers in agriculture has been increasing at enormous rate except during 2010-11 to 2020-21 which indicated a nearly nil growth in their use. The regulated markets have shown a minimal increase of 7.69% since 1990s. But one of the major social infrastructural components which have been neglected is the Primary Health Centres which has shown a negative growth rate since 2000-2001.

Growth of Agricultural Productivity

According to Punjab Government statistics, Agriculture contributes about 28.00 per cent to the gross domestic product and about 66.00 per cent of population in rural areas is engaged in this profession. The green revolution initiated in mid sixties for wheat and early seventies for rice triggered a high growth trajectory. In the state of Punjab wheat and paddy are the most dominating crops accounting for about 80.00 per cent of the gross cropped area. The state has only 1.54 per cent area of the total geographical area of country but contributing about 80.00 per cent towards the central pool of wheat and paddy for last two decades. The cropping intensity and irrigation potential has already been fully exploited and the growth in productivity has also reached at a saturation point. Therefore, agriculture sector is showing slow growth trend over a period of time. Besides, farmers are not ready to take risk due to assured returns of wheat & paddy and very few advances have taken place in R&D in this sector. Most of the growth is generally due to increase in the MSP of Wheat and Rice every year than due to increase in production. The trend of the productivity in major crops in the Punjab state can be viewed from the table which has showed the area, production and yield of two traditional and commercial crops.

Table7: Area, Yield and Productivity of Major Crops (1990-91 to 2020-21)

MAJOR CROPS		1990-91	2000-01	2010-11	2020-21
RICE	AREA	2024	2611	2831	2928
	PRODUCTION	6535	9154	10837	12783
	YIELD	3229	3506	3828	4366
WHEAT	AREA	3272	3408	3510	3530
	PRODUCTION	12155	15551	16472	17186
	YIELD	3715	4563	4693	4868
TOTAL FOOD GRAINS	AREA	5750	6281	6510	6604
	PRODUCTION	19300	25324	27846	30418
	YIELD	3390	4032	4280	4606
COTTON	AREA	701	474	483	251
	PRODUCTION	1909	1199	2100	1022

	YIELD	463	430	646	691
SUGARCANE	AREA	101	121	70	89
	PRODUCTION	6000	7770	4170	7487
	YIELD	59406	64215	59571	83841

Note: Area (thousand hectares), Production (thousand tonnes), Yield (kg per hectare).

Source: Handbook of Statistics on Indian States, RBI and Economic Survey, GOP.

It is vivid from the table that the total food grain production in Punjab has increased significantly during 1990-91 to 2020-21. In 1990-91, the total food grain production was 19300.7 thousand tonnes which has increased to 30418 thousand tonnes in 2020-21. It is observable that in 1990-91, the area under total food production was 5750.8 thousand hectare which has increased to 6604.0 thousand hectares in 2020-21. Similarly, the yield of total food grain has reached to 4280 kg per hectare in 2010-11 and has become 4606 kg per hectare in 2020-21. The area under cultivation of wheat has been increased over the time and reached to 3530 thousand hectares in 2020-21. Consequently, the yield of wheat has increased to 4868 kg per hectare during the period of 2020-21. It is lucid that the area and yield of rice has been increasing since 1990-91 and has reached to 2928 thousand hectare and 4366 kg per hectare respectively in 2020-21. Turning towards commercial crops, the area under cotton has become approximately one third in the period 2020-21 as compared to 1990-91 when it was 701 thousand hectares. This means there is drastic decline in area under cotton crop in Punjab. Surprisingly, the yield of the cotton has been increasing since 1990-91 and has reached to 691 kg per hectare in 2020-21. In 1990-91, the production of cotton was 1909 thousand tonnes which has reached to 1022 thousand tonnes in 2020-21. Somewhat similar trend can be viewed from the yield of sugarcane. The area of sugarcane has also declined during 1990-91 to 2020-21. During 1990-91, it was accounted to 101 thousand hectares but moving towards recent time period it has declined to 89 thousand hectares. The yield of sugarcane has also shown a rising trend and has accounted to 83841 kg per hectare in 2020-21. The production of sugarcane has also increased in the current period but had experienced a decline in 2010-11 when it was 4170 thousand tonnes.

Table 8: Percentage change in Area, Production and Productivity of Major Crops (1990-91 to 2016-17)

MAJOR CROPS		% change (1990-91 to 2000-01)	% change (2000-01 to 2010-11)	% change (2010-11 to 2020-21)	% change (1990-91 to 2020-21)
RICE	AREA	29.00	8.43	3.43	44.66
	PRODUCTION	40.08	18.39	17.96	95.61
	YIELD	8.58	9.18	14.05	35.21
WHEAT	AREA	4.16	2.99	0.57	7.89
	PRODUCTION	27.94	5.92	4.33	41.39
	YIELD	22.83	2.85	3.73	31.04
TOTAL FOOD	AREA	9.23	3.65	1.44	14.85

GRAINS					
	PRODUCTION	31.21	9.96	9.24	57.61
	YIELD	18.94	6.15	7.62	35.87
COTTON	AREA	-32.38	1.90	-48.03	-64.19
	PRODUCTION	-37.19	75.15	-51.33	-46.46
	YIELD	-7.13	50.23	6.97	49.24
SUGARCANE	AREA	19.80	-42.15	27.14	-11.88
	PRODUCTION	29.50	-46.33	79.54	24.78
	YIELD	8.10	-7.23	40.74	41.13

Note: Area (thousand hectares), Production (thousand tonnes), Yield (kg per hectare).

Source: Handbook of Statistics on Indian States, RBI and Economic Survey, GOP.

The data reveals that the production of rice has shown an exceptional increase by 95.61 percent in the overall period which can be attributed to the increase of 44.66% in the area of rice cultivation. In case of wheat, the area and production both have declined since 1991. On the other hand the production of commercial crops i.e. cotton and sugarcane was just satisfactory. The area and production of cotton has decreased drastically and showed an overall negative growth by almost 64% and 46% respectively. However, the yield has increased by 49.24 percent in the overall period. In case of Sugarcane, though there was a reduction in the area of cultivation, the overall production has shown an increase of 24.78% despite a decline during 2000-01 to 2010-11. The area under total food grain has increased by 14.85% during the period 1990-91 to 2020-21. Similarly, the production and yield has also increased by 57.61% and 35.87% during the same period.

Relationship

The development of the agriculture sector is not only dependent on advancement in technology but also on the improvement of agriculture infrastructure. Adequate infrastructure facilities help in raising production and lowering the unit cost of production activities. Infrastructure both physical and institutional such as rural literacy, irrigation, tube wells, roads, electricity, regulated markets, storage capacity and financial institutions etc. together play a key role in determining the agriculture output. Institutional infrastructure such as regulated markets, storage capacity with Government agencies and financial institutions play a pivotal role in the growth of agriculture sector. Development in the regulated markets can encourage the farmers to increase the amount of sale and take products to the market places instead of selling at the farm gate. Financial institutions play a vital role in development of agriculture sector. Financial institutions provide the credit facilities to buy the equipments such as tractors, pump sets and other durables at low interest rate as compared to private money lenders. This institutional credit further reduces the cost of borrowing and increases the investment in production that enhances the returns to the farmers.

The relationship between the agricultural productivity and rural infrastructure can be studied from the results of correlation analysis. The correlation analysis has performed on seven variables as per the availability of data. These variables are number of tube wells (NT), gross irrigated area (GIA), regulated markets (RM), state owned storage capacity (SOSC), regional rural banks (RRB), consumption of fertilizers (CF) and roads. The correlation is performed between these drivers and the production of major crops. The results are shown as below:

Table 9: Results of Correlation Analysis for the Production of Rice (1990-91 to 2020-21)

	RICE PRODUCTION	NT	GIA	RM	SOSC	RRB	CF	ROADS
RICE PRODUCTION	1	.569	.620*	.714*	.614*	.846**	.424	.644*
NT	.569	1	.682*	.790**	.893**	.713*	.576	.939**
GIA	.620*	.682*	1	.792**	.747*	.790**	.427	.695*
RM	.714*	.790**	.792**	1	.774**	.948**	.305	.899**
SOSC	.614*	.893**	.747*	.774**	1	.707*	.749*	.842**
RRB	.846**	.713*	.790**	.948**	.707*	1	.319	.856**
CF	.424	.576	.427	.305	.749*	.319	1	.435
ROADS	.644*	.939**	.695*	.899**	.842**	.856**	.435	1

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

It has been observed from the results of correlation analysis that gross irrigated area (GIA), regulated markets (RM), state owned storage capacity (SOSC), regional rural banks (RRB) and ROADS have shown significant results which means all these variable are having significant correlation with rice production. On the other hand, the remaining indicators of rural infrastructure i.e. number of tube wells (NT), consumption of fertilizers (CF) are showing insignificant results for rice production.

Table 10: Results of Correlation Analysis for the Production of Wheat (1990-91 to 2020-21)

	WHEAT PRODUCTION	NT	GIA	RM	SOSC	RRB	CF	ROADS
WHEAT PRODUCTION	1	.369	.438	.393	.598	.399	.360	.382
NT	.369	1	.682*	.790**	.893**	.713*	.576	.939**
GIA	.438	.682*	1	.792**	.747*	.790**	.427	.695*
RM	.393	.790**	.792**	1	.774**	.948**	.305	.899**
SOSC	.598	.893**	.747*	.774**	1	.707*	.749*	.842**
RRB	.399	.713*	.790**	.948**	.707*	1	.319	.856**
CF	.360	.576	.427	.305	.749*	.319	1	.435
ROADS	.382	.939**	.695*	.899**	.842**	.856**	.435	1

*. Correlation is significant at the 0.05 level (2-tailed).

**.. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis has witnessed insignificant results between the production of wheat and indicators of rural infrastructure. It is also notable that some of the indicators of rural infrastructure have provided significant results with one another but not any indicator is depicting significant results with the production of wheat.

Table 11: Results of Correlation Analysis for the Production of Total Food Grains (1990-91 to 2020-21)

	TOTAL FOODGRAIN PRODUCTION	NT	GIA	RM	SOSC	RRB	CF	ROADS
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TOTAL FOODGRAIN PRODUCTION	1	.513	.626*	.615*	.708*	.698*	.444	.567
NT	.513	1	.682*	.790**	.893**	.713*	.576	.939**
GIA	.626*	.682*	1	.792**	.747*	.790**	.427	.695*
RM	.615*	.790**	.792**	1	.774**	.948**	.305	.899**
SOSC	.708*	.893**	.747*	.774**	1	.707*	.749*	.842**
RRR	.698*	.713*	.790**	.948**	.707*	1	.319	.856**
CF	.444	.576	.427	.305	.749*	.319	1	.435
ROADS	.567	.939**	.695*	.899**	.842**	.856**	.435	1

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

The production of total food grains has shown significant correlation with infrastructure indicators of gross irrigated area (GIA), regulated markets (RM), state owned storage capacity (SOSC) and regional rural banks (RRB).Whereas, insignificant results have been found for number of tube wells (NT), consumption of fertilizers (CF) and roads.

Table12: Results of Correlation Analysis for the Production of Cotton (1990-91 to 2020-21)

	SUGARCANE PRODUCTION	NT	GIA	RM	SOSC	RRB	CF	ROADS
SUGAR CANE	1	-.613*	-.643*	-.795**	-.522	-.893**	-.340	-.724*

PRODUCTION								
NT	-.613*	1	.682*	.790**	.893**	.713*	.576	.939**
GIA	-.643*	.682*	1	.792**	.747*	.790**	.427	.695*
RM	-.795**	.790**	.792**	1	.774**	.948**	.305	.899**
SOSC	-.522	.893**	.747*	.774**	1	.707*	.749*	.842**
RRB	-.893**	.713*	.790**	.948**	.707*	1	.319	.856**
CF	-.340	.576	.427	.305	.749*	.319	1	.435
ROADS	-.724*	.939**	.695*	.899**	.842**	.856**	.435	1

*. Correlation is significant at the 0.05 level (2-tailed).

**.. Correlation is significant at the 0.01 level (2-tailed).

In case of cotton production, all the indicators of rural infrastructure are having negative correlation. This is because of the fact that cotton production in Punjab has significantly decline during the period under study. Even the area under the cultivation has declined.

Table13: Results of Correlation Analysis for the Production of Sugarcane (1990-91 to 2020-21)

	SUGARCA NE PRODUCTI ON	NT	GIA	RM	SOSC	RRB	CF	ROAD S
SUGAR CANE PRODU CTION	1	.175	.499	.681*	.248	.727*	-.224	.470
NT	.175	1	.682*	.790**	.893**	.713*	.576	.939**

GIA	.499	.682*	1	.792**	.747*	.790**	.427	.695*
RM	.681*	.790**	.792**	1	.774**	.948**	.305	.899**
SOSC	.248	.893**	.747*	.774**	1	.707*	.749*	.842**
RRB	.727*	.713*	.790**	.948**	.707*	1	.319	.856**
CF	-.224	.576	.427	.305	.749*	.319	1	.435
ROADS	.470	.939**	.695*	.899**	.842**	.856**	.435	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The results have provided significant correlation only for regulated markets (RM) and regional rural banks (RRB) while, all the rural indicators have shown insignificant results for the production of sugarcane.

Findings

The state which was deficit in food at the time of independence had made rapid strides in agricultural development. Dominating agrarian structure, consolidation of holdings, development of irrigation infrastructure and hard working peasantry led to the early progress. With adoption of new agricultural technology in mid sixties backed with adequate agricultural policies, the state turned surplus in food grains and became a model of India's successful green revolution strategy.

- Infrastructure plays an important role in improving the agricultural production as well as the standard of living of the rural inhabitants.
- Some of the major impediments in the rural infrastructure were the lack of financial support from the government in the form of grants or technological upgradation in irrigation machinery.
- As per the findings, there was a huge increase in the use of chemical fertilisers in agriculture which is definitely going to have a serious impact on the environment in the long term. Proper awareness has to be given to the farmers on the use of fertilisers and a shift from chemical to organic fertilisers has to be encouraged. Issuance of soil health card is the good policy initiative.
- One of the major infrastructural failures is the negligence of health care in rural areas which has shown a decline in the indicators as provided in the data. Health which impacts the efficiency of the

farmers and agricultural labourers has a direct relation with the agricultural productivity. Therefore, more public investment is required in this sector.

- If the economic growth in the state has to be increased, then the financial resources have to be raised for improving infrastructure by allocation of government resources and raising investment from private or international sources.
- The issue of quality and management failure have to be rectified by good governance in Punjab. Because, the allocation of financial resources in infrastructure can affect the development of other sectors in the short run, and returns from these in the long run perspective would be high in terms of higher rate of economic growth.
- Still, there is overdependence of rural population on agriculture sector. There is the need to provide non- farm productive employment so as to reduce population pressure on agricultural sector.
- As per the CEA (Central Electricity Authority) data of 2011 census, 100 percent of the villages are electrified. Blanket free power to the agricultural sector is neither viable nor desirable economically and environmentally. Instead of providing free power to the farmers, government should seriously think about providing power subsidy via Direct Benefit Transfer to small and marginal farmers. The small and marginal farmers have to pay the cost of power. Environmental implications of free power supply and over exploitation of ground water are very serious.
- Rather than free power to every farmer, government should invest more in the rural infrastructure especially the social infrastructure including quality education and health services.
- Furthermore, it is not the advancement of technology, but equally important is the requirement of infrastructure to spread the available scientific information and technology among the large number of farmers, which require adequate number of agriculture extension workers.

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