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Rural road network and agricultural growth linkages in various agro-climatic zones of Bihar: An economic analysis

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Abstract

Road is a major economic infrastructure and it is essential for improving living condition and helpful in acceleration of the socio-economic conditions. This infrastructure also stabilizes the agricultural growth and creates opportunities of employment, income, livelihood, enhance nutritional level, diversification of farm, market access in agricultural, industrial and services sectors. Expenditure on rural road in Bihar indicates that in between triennium ending 2001-03 to 2021-22 around Rs.7748 crores expended for construction of 120503 kms of rural roads in the state which covers around 78.00 percent of the total village roads in the state. During the same period a significant increase in total food grains production was recorded and it was about 50.66 percent. The per capita income was found increased from Rs 25653.00 to Rs 55055.00 in the same period. In this background present paper is constructed to assess the linkages between construction of rural roads and development of agriculture in the state and different zones as a major objective. The study is based on secondary level data collected from various published and un-published sources. The study finds that due to construction of rural roads in rural areas farmers and common people access the facilities of insurance, KCC, subsidies on tractors, agricultural implements & machinery, facilities of soil testing laboratory, increases in the consumption of quality seeds and easily access cold storage & go downs after construction of rural roads. Across the zones the construction of rural roads were not found uniform and it was found that in (zone-I) 51,471 Kms. in (zone-II) 25,601 kms. in (zone- IIIA) 11,337 kms and in (zone-IIIB) 31,868 kms. Accordingly the growth of agriculture and economic parameters found varied across the zones. At the overall level study finds that the impact of rural roads on agricultural practices, productivity and some extent diversification of farm observed a significant positive impact on those areas where rural roads network was high. The rural roads also serve as the feeder roads as well as the roads for inter-village movement up to nearest town, district and state in some extent it helps in backward and forward linkages in agricultural activities but it also proved a big cause for migration of working population for searching of better wage and employment and is responsible for crisis of labourers for agricultural purposes in peak period. The study also finds several interesting findings and linkages for socio economic development after construction of rural roads.

Keywords: Rural road, agricultural growth, Bihar

Introduction

The role of roads in economic development is well recognized. This is a basic infrastructure which contributes largely for the development of rural and agricultural economy. In the state of Bihar around 89.00 percent population lives in rural areas (9.26 crores) as per census, 2011 and dependent on agriculture activities for their livelihood. A change in outlook toward construction of roads in the state gaining importance after separation of state in the year 2000. The emphasis on construction of rural roads gains priority after the introduction of road maps. Expenditure on rural road in Bihar indicated that in triennium ending 2001-03 only Rs 334 crore expended by the government after that a significant increase in expenditures on roads were recorded and up to 2021-22 it rises to around Rs 7748 crores (about 22-fold). In the same period length of roads increase to around 120503 kms from 836 kms. In the total road constructed in the state, rural roads concentration was quite high more than 78.00 percent. These roads were constructed under the various Schemes like GTSNY, MMGSY, PMGSY, etc. This indicates a significant increase in the rural road network. As per agro-climatic conditions whole state has been divided into four sub agro-climatic zones. The zone I is largest in terms of geographical area (34,49000 ha.) followed by zone IIIB (29,16000ha), Zone II (1798000 ha.) and Zone IIIA (11960000 ha). The total geographical area of state is (93,59000 ha) (DES, GOB 2021).

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The construction of rural roads across the zones is not uniform and is found that in zone-I 51471 kms., in zone-II 25601 kms in zone- III 43205 kms. (11337 kms & 31868 kms, respectively). The agricultural practices, cropped areas, cropping pattern, productivity, use of inputs, employment, income, migration and poverty level also significantly varied across the region.

The investment in rural road accounted for 11.80 percent in 2005-06 and it increased up to 46.70 percent in 2021 of expenditure on economic services. Since the year 2000 both governments i.e. central and state had emphasis on the development of rural roads on the assumptions that rural roads will be helpful for rural people by connecting them to improved agricultural practices, better market access and additional employment generation. This development is pre-requisite for socio-economic development and poverty reduction particularly in agriculturally backward state of Bihar where about 88 percent of people live in rural areas and is directly or indirectly dependent on agriculture for their livelihood. In the state about 75 percent of the workforce are reported engage in agricultural activities. As per latest report of NITI Ayog it was reported that the share of multi-dimensional poor people is about 51.90 percent, population living below the poverty line 33.74 percent, population deprived from nutrition 42.20 percent, population deprived from schooling 22.29 percent, population deprived from cooking fuel 63.30 percent, population deprived from housing

65.37 percent are the chronic problem of this state. In this situation study of rural roads and their linkages with agricultural practices is of high importance. This type of study has not been taken till and will be helpful for policy makers to develop suitable policies for proper development in future.

In light of the above, this paper has been prepared and an attempt has been made to analyse the effect of rural road on agricultural growth in the state of Bihar as major objective. The methodology adopted for attending the objective was statistical research method of data collection like secondary data which is available in large amount in the form of published statistical reports, books, journals, bulletins, magazines, internet, other literature material and un-published sources like regional, district and rural development offices. The study was confined in the state of Bihar and its various agro-climatic zones.

Agro-Climatic Zone in Bihar

As per agro-climatic conditions presented in table-1 the whole state has been divided into four sub agro-climatic zone namely North west alluvial plain, North east alluvial plain and South alluvial plain (Zone IIIA and IIIB). The zone-I comprises 13 districts, zone-II comprises 08 districts and zone-III comprises 17 districts (06 districts in IIIA and 11 districts in IIIB). At present in the state there are total 38 districts.

Table 1: Background of various Agro-Climatic Zone in Bihar

Particulars	Zone-1 NW alluvial plain	Zone-II NE alluvial plain	Zone -III South alluvial plain	
			Zone-IIIA	Zone-IIIB
Number of Districts	13	08	06	11
Geographical area	3449000ha (36.85%)	1798000 ha (19.0%)	1196000 ha (13.0%)	2916000 ha (31.15%)
Net Sown area	2255989 ha (39.49%)	1181570ha (20.68%)	540892 ha (9.47%)	1733637 ha (30.36%)
Total cropped area	3109650 ha	1866356 ha	637489 ha	22688882 ha
Total irrigated area	1401153 ha (40.62%)	915023 ha (50.89%)	377214 ha (31.54%)	1873444 ha (64.25%)
Total population	4.69 crore (45.03%)	1.86 crore (17.9%)	0.98 crore	2.88 crore
Rural area %	92.22	92.83	84.87	86.10
Urban area %	7.78	7.17	15.13	13.90
Kaccha + pakka rural road (in kms)	51471	25601	11337	31868

Source: Directorate of Economics and Statistics GoB, Road construction and Rural works department Government of Bihar, Patna

The zone-I is largest in terms of geographical area (34,49000 ha.) followed by zone IIIB (29,16000ha), Zone II (1798000 ha.) and Zone IIIA (11960000 ha.). The total geographical area of state is about 93,59000 ha. In the various zones rainfall are significantly varied and is ranging between 1040 mm to 1450 mm in zone 1 with an average rainfall 1245 mm. In zone II, it ranges between 1200 mm to 1700 mm and average is 1450 mm, in zone III it ranging between 990 mm-1240 mm and average of the state is 1115 mm. As per data in the state about 57.12 lakh hectare net sown area is available and is spread under zone-I around 22.56 lakh ha, in zone-II 11.82 lakh ha, in zone- IIIA 5.4 lakh ha and in zone- IIIB 17.34 lakh ha. The total cropped areas in zone -1 is around 31.00 lakh ha, in zone II is 18.66 lakh ha in zone IIIA 6.37 lakh ha and zone IIIB is 22.69 lakh hectares. The gross irrigated area in zone I is about 14.01 lakh ha (40.62%), in zone -II is 9.15 lakh ha (50.89%), in zone -IIIA is 3.77 lakh ha (31.54%) and zone -IIIB is 18.73 lakh ha. The above analysis indicates that zone-I is highly dependent on agriculture followed by zone-III and zone-II in the state due to

high concentration of rural population and net sown area.

Land Distribution (Zone-Wise) in the state

Land distribution in the state as zone-wise has been presented in table-2 The table reveals that in the state total land is 93.59 lakh hectares and out of it net sown area is around 61.03 percent (57.12 lakh hectares). Net sown area utilized in more than one season is about 38 percent only in a year due to floods, water logging, and irrigation water crisis. The table further shows that zone-I constitute 36.85 percent of total land and 39.49 percent of net sown area in the state. The zone-II possesses only 19.00 percent of total land, 20.68 percent of net sown area of the state and net sown area utilized more than one in a year only 23.67 percent. The zone III A constitutes only 13.00 percent of total land and 9.47 percent of net sown area in the state. Net sown area utilized more than once only 8.08 percent. Zone- III contributes 31.15 percent of total land and 30.36 percent of net sown area in state.

Table 2: Agro Climate Zone- wise land distribution in Bihar

Particular	Land	Percentage share of the State			
	Bihar	Zone I	Zone II	Zone IIIA	Zone IIIB
Total Land	9359000	36.85	19.00	13.00	31.15
Net Sown area	5712088	39.49	20.68	9.47	30.36
Total crop area	7882377	39.45	23.67	8.08	28.80

Source: Central water Commission, and Directorate of Economics & Statistics, GOB, Patna (2020-21)

Net sown area utilized more than once in a year only 38.80 percent. This analysis clearly indicates that the net sown area

Table 3: Distribution of land holding size and operational holding in Bihar

Categories of farm	No of Holdings (%)	Operational Holdings (%)	No of Holdings (%)	Operational Holdings (%)	No of Holdings (%)	Operational Holdings (%)
	Year 2001		Year 2011		Year 2021	
Marginal below 1 Hac.	82.90	40.80	91.21	57.73	91.06	57.43
Small (1-2 Hac)	9.60	19.00	5.75	18.24	5.85	18.56
Semi medium (2-4 Hac.)	5.70	23.10	2.52	16.66	2.56	16.79
Medium (4-10Hac.)	1.70	14.30	0.49	6.67	0.50	6.49
Large (10 & above Hac.)	0.10	2.80	0.018	0.69	0.018	0.70

Source: Agricultural census division, Ministry of Agriculture, New Delhi

The table further shows that semi medium, medium and large holdings were also declining during the period. This indicates the breakup of united family to nucleus family and land was distributed in divided family. This analysis shows that the holding size of the state is un-economic.

Cropping pattern of the state

It may be seen from the table no-4 cropping pattern of the state is largely depends upon food grains and it constitute more than 93 percent. It means farming practices in the state is still traditional and least diversified. Amongst food grains cereals constitutes about more than 85 percent followed by pulses with nearly 7.00 percent and other crops 6.5 percent. The main reason of cereals dominance in the state is consumption pattern of people not for commercial temperament of farmers. Across the triennium ending 2003 to 2021 pulses are not goes up to 10 percent in cropping pattern it indicates the poor implementation of pulses development programme in the state. It may also says that no significant impact of rural roads construction in rural areas under agricultural practices particularly in pulses.

Table 4: Cropping pattern of the state from (triennium ending 2001 to 2021)

Triennium ending	Food grains (%)	Cereals (%)	Pulses (%)	Other crops (%)
2001-03	92.23	82.94	9.29	7.77
2003-06	93.46	84.80	8.66	6.54
2006-09	94.68	86.63	8.13	5.24
2009-12	92.73	84.78	7.92	7.30
2012-15	93.09	85.59	7.71	6.70
2015-18	93.73	86.66	6.99	6.35
2018-21	93.45	86.47	6.87	6.66

Source: Economic surveys of Bihar & Bihar through figure (various issues)

It may be concluded that after several efforts taken by the central and state government farmers are not changing their attitudes towards diversification of their farms and that compel for study in this context.

and total cropped area found varied with variation of agro-climatic zones in the state due to several factors like natural and manmade.

Distribution of land holding size

Table.3 stated below shows the distribution of holding size and operational holdings in the state during the past two decades. It reveals that the number of marginal holdings and operational holding increases since the year 2001 to 2021 and small holdings declined during the same period from. 9.60 percent to 5.85 percent.

Production of food grains in Bihar

It is observed from table. 5 that the production level in the state started increase in food grains. In the triennium ending 2003-06 food grains production was 118.73 lakh tonnes which increases 184.86 lakh tonnes during 2021-22. It was mainly due to positive impacts of government programme on agriculture, implementation of Road Map and construction of roads. The table further indicates that the increase was more fast since 2012.

Table 5: Production trend of food grains in Bihar (Lakh tonnes)

Triennium ending	Production (Lakh tonnes)	Change	
		In Quantity (Lakh tonnes)	(%)
2001-03	122.70	--	--
2003-06	118.73	(-3.97	(-3.23
2006-09	116.21	(-6.49	(-5.28
2009-12	153.74	(+31.04	(+25.29
2012-15	153.38	(+30.68	(+25.00
2015-18	181.43	(+58.76	(+47.86
2018-21	178.39	(+55.69	(+45.38
2021-22	184.86	(+62.16	(+50.66

Source: Economic surveys of Bihar & Bihar through figure (various issues)

Thus, we conclude here after construction of roads and easy to access inputs for cultivation the increase in the food grains production was significant.

Productivity level of major crops in Bihar

Table.6 shows that since triennium ending 2003-06 a significant increase in cereals production was observed. The table again shows that the productivity level of pulses is almost stagnant or slight increase but no definite trends. The same trends were observed in Kharif and Rabi pulses. It was found that the productivity level of oilseeds was increases due to implementation of oil seeds development programme in the state.

Table 6: Productivity (kg/ha) levels of major crop in Bihar

Triennium ending	Cereals	Total pulses	Kharif pulses	Rabi pulses	Total oilseeds
2001-03	1733	803	913	843	828
2003-06	1635	855	965	813	864
2006-09	1719	911	1029	901	849
2009-12	2047	645	1121	797	985
2012-15	2368	848	892	841	1093
2015-18	2694	911	854	895	1140
2018-21	2726	847	841	963	1184
2021-22	2968	887	794	967	1077

Source: Economic surveys of Bihar & Bihar through figure (various issues)

Status of Fruits and Vegetables in the state

In the state litchi is cultivated under 36.24 thousand hectare and is slightly increased to 36.67 thousand hectares. The production level ranges between 307 to 308 thousand tonnes per annum. Mango is cultivated in around 5.17 thousand hectares and produces around 46 thousand tonnes of mangoes annually. Other fruits like guava, banana, jackfruit, muskmelon, papaya, watermelon, etc. are also grown in the state. The total fruits area in the state is around 2.80 lakh hectare. In the state vegetables like potato, onion, brinjal, bitter guard, bottle guard, capsicum, vine vegetables etc. are grown in large area i.e. 8.25 lakh hectares. In recent past flower cultivation has also been started by the farmers and is grown under 300 hectares. The spices crops like garlic, ginger, turmeric, chillies, coriander are also cultivated. This indicates positive impacts on the diversification of farm after construction of rural roads.

Length of rural roads in Bihar

It could be seen from table.7 that road length network increases significantly during past two decades. The table further shows that the increase in pakka roads fastly increased as compared to kaccha roads during referred period due to heavy expenditure on metallic roads in the state. Table again shows that since 2009 and onward, construction of roads gaining momentum in state due to serious efforts taken by the government and as per instruction of the world bank.

Table 7: Length of rural roads in Bihar

Triennium ending	Pakka Road (Kms.)	Kachha Road (Kms.)	Total Road (Kms.)
2001-03	NA	-	-
2003-06	836	-	836
2006-09	NA	-	-
2009-12	42883	-	42883
2012-15	57970	-	57970
2015-18	76256	-	76256
2018-21	97524	-	97524
2021-22	102306	18197	120503

Source: Department of Rural workers Government of Bihar

The above noted analysis clearly indicates that there is a significant increase in roads construction and road networks that spread very fast in the state.

Investment for Rural roads in Bihar

As observed from table.8 it is clearly indicates that a huge amount every triennium year invested on road construction and the table is self explanatory.

Table 8: Investment on Rural roads in Bihar

Triennium ending	Expenditure (Rs crore)	% increase over 2001-03
2001-03	334	-
2003-06	404	20.95
2006-09	NA	-
2009-12	1204	260.48
2012-15	7884	883.83
2015-18	7287	2081.73
2018-21	2036	509.58
2021-22	7748	2219.76

Source: State Budget Document Department, Government of Bihar, Patna

The table shows that since 2009 a significant increase in expenditure on roads as per data in the table and up to the triennium ending 2021-22 it reached up to 7748 crores.

Agricultural Growth Linkages

Since 2001 to 2022, huge investment was made on the roads for construction. In this period, micro irrigation level reached 115500 ha (Drip-10502 & Sprinkler 104998 ha). The capacity of cold storage increased up to 22.10 lakh tonnes. Consumption of fertilizers in the form of urea has reached 2287.0 thousand tonnes, DAP 732.0 thousand tonnes, SSP 90.0 thousand tonnes and MOP 272.0 thousand tonnes in the state. Requirements and availability of quality seeds was 353.54 lakh quintals and 398.88 quintals respectively. In the state during the year 2019-20 Rs 1788625.00 lakh was disbursed as crop loan and Rs 1794144.00 lakh as term loan in this way a total of Rs 3582769.00 lakh agricultural loan disbursed in the state. Under National Agricultural Insurance Scheme about 10707824 farmers were covered, under weather based crop insurance scheme 12798379 farmers were covered and 10634599 farmers were benefited, In Pradhan Mantri Fasal Bima Yojna 5017309 farmers were covered and 434925 farmers were benefited. Around 77.05 lakh KCC were issued. This indicates a positive change after networking the rural roads in the state. Status of farm implements up to 2021-22 shows that in zone-I, 2984 farm implements, 680 pump sets, one power tiller and 203 threshers were available for agricultural purposes. In zone II, 1078 farm implements, 237 pump sets, zero power tiller and 153 threshers were available for the purpose. In zone IIIA, 332 farm implements, 85 pump sets, 4 power tillers and 30 threshers were available. In zone IIIB, 2688 farm implements, 273 pump sets, 117 power tillers and 189 threshers were available. The (Credit: deposit) C:D ratio in same year shows that in zone I it was 40.46, in zone II 55.00, in zone IIIA 38.06 and in zone IIIB 38.41 indicates very low C:D ratio across the zone. The per capita income in 2017-18 as per 2011 base year indicates that in zone I Rs 24.46 thousand, in zone II Rs 21.10 thousand, in zone IIIA Rs 26.93 thousand and in zone IIIB Rs 32.75 thousand which is still far below the national average. This indicates no strong linkages were developed in between road infrastructure and agricultural development as was expected but moderately agricultural activities across the zones were improved as indicated by various parameters.

Main Problems Identified

Zone-wise major problems identified in agricultural development listed below

Zone-I

1. Subsistence Agriculture and lesser degree of diversification of agriculture.

2. Low crop productivity due to soil salinity
3. Erratic crop production due to flood every year
4. Irrigated land is blow 30 percent of the total cultivable area.
5. Low adoption of scientific technologies due to lack of resources to marginal and small farmers.
6. Market facilities and other infrastructures facilities are inadequate.
7. Potential for horticultural crops but processing level is very low.
8. Farming systems for flood and water logging are not available.

Zone-II

1. Due to recurring floods erratic crops production.
2. Irrigation level is very low.
3. In north eastern part soils are mostly acidic.
4. In this zone micro-nutrients deficiency occurred due to leaching.
5. Complete absence of processing industries and market infrastructure.

Zone-III

1. Zone is agriculturally developed but both Tal and Diara area covered a large area.
2. Due to water logging conditions in Tal and Diara area only mono cropping (rabi season) is suitable for agricultural practices.
3. Lack of storage facilities, marketing facilities in remote area is a big problem.
4. Poor input delivery system.

These above noted problems are main and powerful barrier in crop production on sustainable basis across the agro-climate zones. In the entire zone there is need for effective planning for profitable farming. In the agro-climatic areas integrated farming system needs to be focused for maximizing farm returns and livelihood generation.

Conclusions

The above discussions says that the construction of rural roads bring a positive impact and linkages under agricultural practices particularly in rural areas where more than 88 percent population resides. But still there is a vast scope for its development by the practice of multiple cropping, crop rotation, inter-cropping, mixed cropping with allied activities like horticulture activities, livestock activities, fisheries activities, cash crops, spices, commercial crops, etc. for making profits in farming and creation of livelihood in the areas for restoring farmer's faith in farming and also justifying rural roads investments in Bihar.

Suggestions

On the basis of above discussions, following suggestions could be made as inputs for policy makers-

- A. Promoting good infrastructure of financial network, input delivery, irrigation and drainage in the study areas
- B. Facilities for food processing establishments in the area for better improvements in farmer income.
- C. Custom hiring facilities required popularization in the areas for mechanization of crops.
- D. The government should give emphasis on popularization of micro irrigation practices for cost effective and better production possibilities of cash crops and vegetables in

various zones.

- E. Focus on skill development, knowledge transfer for improved agricultural practices particularly in abiotic stress conditions.

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