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## **Impact of Roads on Rural Agriculture Economy: Evidences From Tamil Nadu**

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### I

#### INTRODUCTION

The importance of infrastructure for the development of rural areas needs hardly any emphasis. Provision of adequate and quality infrastructure in rural areas facilitate improvement in productivity and efficiency of capital in agriculture, improving the credit absorption capacity of the area, generating employment, increasing farmers' income, etc., besides improving the quality of life of people in the benefited areas. The ultimate results of the commercial farming will not be realised fully without quality supporting infrastructure. It is estimated that 15 per cent of crops are lost between the farm gate and the consumer in the world because of poor roads and storage facilities (World Bank, 1997).

An improvement in connectivity through transport infrastructure enhances the mobility of factors of production brings about reduction in cost and time, facilitates expansion of markets and economies of scale together with enhanced efficiency in factor market operations. Easier access to markets allows area expansion under the production of perishable and transport-cost-intensive products. Timely marketing of perishable products allows better price discovery. The cumulative effects of infrastructure accentuate the process of commercialisation in agriculture and rural sector (Jaffee and Morgan, 1995).

The issue relating to the role of rural roads in economic development remains largely unsettled. However, there is an agreed view that good rural roads are a necessary condition, but not a sufficient condition, for rural and overall economic development. Various study results from Mexico (Elmondorf and Merrill, 1977), Philippines (USAID, 1978) established improvement in economic, social and human service indicators as a result of improvement in rural roads. A detailed study in India (Bansil and Patil, 1979) on the socio-economic impact of roads on village development observed that the effect of accessibility was greater for unimproved than for improved roads suggesting that in bringing about socio-economic change, the

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existence of some kind of trafficable route is of major importance, its quality is a second-order consideration.

Improved connectivity facilitates better access to social necessities like health care centers, education institutions (Nair, 2003) and access to mainland in the case of isolated villages as shown from the evidences from Thailand (Moore, 1980). Investment in roads can also bring in new area under cultivation and increased intensity of land use, composition of employment (Ahmed and Hossain, 1990), growth of agricultural output (Binswanger *et al.*, 1989), increased use of fertiliser (Badatya and Nair, 2004) and bank expansion. This paper presents the findings of a study conducted in Dindigul district in Tamil Nadu.

## II

### METHODOLOGY

The major objective of the study was to assess the impact of rural roads in terms of increased income on farm sector of the benefited area. The field study was conducted during January 2003 with calendar year 2002 as reference year of the study. The study covered 120 road users who were interviewed personally using pre-drawn schedules. The samples were drawn randomly almost equally from the selected villages and covering various sections of the society. Gross net income gains from the investment in new road has been identified as:

$$ING_{fs} = \Sigma (I_g + C_s)$$

Where,

$ING_{fs}$  = Individual net gains to farm sector,

$I_g$  = Income gains due to the improved road,

$C_s$  = Cost savings due to the improved road.

Income gains from the improved connectivity has been further estimated as:

$$I_g = \Sigma (I_{cpa} + I_{pp})$$

Where,

$I_{cpa}$  = Income (net) from change in cropping pattern and cropped area,

$I_{pp}$  = Increase in income due to increased price of product,

Similarly, total savings in farm sector has been defined as:

$$C_s = \Sigma (S_{coc} + S_{tc} + S_{wt})$$

Where,

$S_{coc}$  = Saving in cost of cultivation,

$S_{tc}$  = Savings in transportation cost,

$S_{wt}$  = Savings in wastage while transporting.

Net incremental income from farm operation has been worked out as differential net income during the *before* and *after* road construction period. Thus farm incremental income will take the form of:

$$INI_{fs} = NI_{far} - NI_{fbr}$$

Where,

$INI_{fs}$  = Individual net incremental income from farm,

$NI_{far}$  = Net income from farm operation after the road (reference year),

$NI_{fbr}$  = Net income from farm operation before road construction.

The benefits received by the sample were blown up to the total benefited area to estimate the macro impact of the investment.

$$GNI_{fs} = INI_{fs} / H \times GBA$$

Where,

$GNI_{fs}$  = Gross net income from the farm sector in the benefited area,

$IG_{fs}/H$  = Per hectare total gain from farm due to improved road,

$GBA$  = Gross benefited area of the road.

### III

#### BENEFITS TO FARM SECTOR

The study covered Parikavai - Kookal - Palamputhur road in Kodaikanal taluk in Dindigul district (Tamil Nadu) financed under Rural Infrastructure Development Fund (RIDF) of NABARD. The construction of the roads started in 1998 and was completed by December 2000. The total length of the road was 19.6 KM. There were three minor bridges (two bridges with 9.6 m length and one bridge with 10.4 m length) with 7m approach in the road. Total cost of the works covered under the study was Rs.463.77 lakh. All the six hamlets in the benefited revenue village (Kookal) are located in the middle of reserve forest and about 5500 ft above MSL. The agro climatic condition in the villages was appropriate for high value vegetable cultivation. Agriculture was the major activity in the benefited villages with more than 96 per cent of the people depending directly on it. Gross cropped area in the benefited villages was estimated to be 2413 ha.

Earthen road existed before development and was subjected to damages during rains and the surface was uneven for vehicular traffic. Only lorry traffic and very rarely jeep traffic was possible before development. Vegetable transportation through the road was possible only by lorries with heavy damages. Apart from the routine damages through staggered transportation, during the rainy season lorries often were caught in some marshy areas and it took two-three days of efforts to revive the journey. The entire/part of the output was damaged during such mishaps and almost all the farmers experienced at least one or two such mishaps within every 5 years.

### Savings in Cost of Cultivation

The financial benefit on account of development of road on cost of cultivation was only in terms of reduction of input transportation costs. Transportation cost of fertiliser averaged to Rs.24 per bag in the pre-road developed period which reduced to Rs.14 per bag of 50 kg during the reference year (Table 1).

TABLE 1. COST OF CULTIVATION IN THE SAMPLE FARM

Crops (1)	<i>(Rs./ha)</i>									
	Fertiliser				Farmpower/ labour	Input transport		Total cost		Change (per cent) (10)
	Seed (2)	and FYM (3)	Pesticide (4)	others (5)	Pre- (6)	Post- (7)	Pre- (8)	Post- (9)		
Potato	10325	10819	3137	8843	1245	726	34368	33849	-1.51	
Carrot	6496	10621	2569	14005	1126	657	34817	34348	-1.35	
Cabbage	4199	8793	3211	6422	948	553	23574	23178	-1.68	
Garlic	27516	15944	8991	12634	1601	934	66685	66018	-1.00	
Green peas	6916	3285	618	6546	356	207	17720	17572	-0.84	
Beans	4137	3446	1420	3569	296	173	12869	12745	-0.96	

It was also observed that reduction in the transportation cost had not influenced the input mix or productivity of crop as the inputs at desired level were available at the farm, though at higher transportation costs. Based on the cropping pattern of the sample farm (Table 2) and the fertiliser use for each crop, net reduction in the cost of cultivation was worked out to Rs. 660 per year for the sample farm. As the sample farm was of 1.38 ha, reduction in cost of cultivation per ha. averaged to Rs. 479 per year. Since the gross cropped area in the benefited villages was 2413 ha, total cost reduction worked out to Rs. 11.56 lakhs per year.

TABLE 2. CHANGE IN CROPPING PATTERN AND NET INCOME

Crops (1)	<i>(Rs.)</i>								
	Pre-development				Post-development				Incremental income (10)
	Area (ha.) (2)	Cost of cultivation (3)	Total income (4)	Net income (5)	Area (ha.) (6)	Cost of cultivation (7)	Total income (8)	Net income (9)	
Potato	0.83	28,524	52,145	23,621	0.85	29,080	53,162	24,082	461
Carrot	0.28	9,726	19,988	10,262	0.29	10,008	20,567	10,559	297
Cabbage	0.02	477	956	479	0.03	668	1,339	670	191
Garlic	0.06	4,320	8,044	3,724	0.07	4,860	9,049	4,190	466
Green peas	0.02	359	802	444	0.02	359	802	444	0
Beans	0.10	1,250	2,466	1,216	0.10	1,250	2,466	1,216	0
Firewood	0.05	0	585	585	0.02	0	270	270	-315
Total	1.36	44,656	84,986	40,331	1.38	46,225	87,655	41,431	1,100

### *Change in the Cropping Pattern and Cropped Area*

Improved road condition has made easy access to credit and farm machineries (like excavator, bulldozers, tractors, etc.) in the area which facilitated irrigation in the farm. The net area owned by the sample farmer at 1.14 ha had not changed with improved connectivity. However, improvement in the irrigation facilities had brought in marginal expansion in the area under irrigation- from 23 per cent of net area in the pre road development situation to 24 per cent in the reference period, consequently, the gross cropped area also increased from 1.36 ha. to 1.38 ha.

Increase in the gross cropped area worked out to 0.89 per cent for three year period, i.e., roughly 0.30 per cent increase per year. Further, the cropping intensity also showed marginal improvement from 125.3 per cent to 128.6 per cent in the post-road developed situation. The crops cultivated by the sample farms also underwent change on account of investment in rural roads which facilitated easy and timely access to market, etc. Area under cabbage, garlic, potato and carrot cultivation increased at the cost of area under firewood which was less remunerative. As evident from Table 2, net incremental income per sample farm was worked out to Rs. 1,100 per year and the same averaged to Rs.797 per ha. during the reference year. When the same was utilised for total benefited area it worked out to Rs. 19.23 lakh at reference year price.

### *Price Gains from Timely Marketing*

As indicated earlier new road facilitated timely marketing of the vegetables. During the pre-development situation, transportation of vegetables took nearly 35 to 45 hours to reach the market, thereby adversely affecting the freshness and quality of vegetables. With the improved roads, it was possible for the farmers to consign the vegetables within 15 hours to the market maintaining its freshness and with minimum damages fetching them better prices. The price gains varied from no change in the price of garlic to Rs. 20 per quintal in the case of green peas. The major vegetables, like potato and beans received Rs. 8 per quintal, carrot received Rs.6 per quintal and cabbage Rs.3 per quintal more when compared to pre development situation (Table 3).

TABLE 3. BENEFIT FROM PRICE GAIN

Crops (1)	Area/ sample (ha.) (2)	Yield (qtl/ha) (3)	Price gain (Rs./qtl) (4)	Production/farm (qtl) (5)	(Rs.)
					Amount gained (6)
Potato	0.85	121.5	8.0	102.83	823
Carrot	0.29	175.4	6.0	50.41	302
Cabbage	0.03	282.8	3.0	8.02	24
Garlic	0.07	28.2	0.0	2.05	0
Green peas	0.02	33.6	20.0	0.68	14
Beans	0.10	52.1	8.0	5.06	41

The average amount gained per farm of the size of 1.38 ha. was worked out to Rs.1,203. Hence per hectare benefit under this head worked out to Rs.872 and the total benefit to the benefited area worked out to Rs. 21.04 lakh per year.

#### *Saving in Transportation Costs*

Transportation cost for marketing of output in the benefited area was reduced, substantially, when compared to pre road development situation. All the farmers in the benefited area marketed vegetables either to Vathalakundu, i.e., 90 km away or to Madurai, which was 140 km away from the benefited area. Transportation charges that ranged from Rs. 80 to 105 per quintal (Table 4) came down to the range of Rs.64 – 90 per quintal with improved roads. Savings in transportation cost was Rs. 15 to Rs.17 per quintal.

TABLE 4. REDUCTION IN TRANSPORTATION COST

Crops (1)	Transportation cost (Rs./qtl.)				Production/farm (qtl) (6)	Savings in transportation cost/ farm (7)
	Pre- (2)	Post- (3)	Savings (per cent) (4)	Value (Rs./qtl.) (5)		
Potato	91	75	21.3	16.0	102.83	1645
Carrot	81	65	24.6	16.0	50.41	807
Cabbage	81	64	26.6	17.0	8.02	136
Garlic	80	64	25.0	16.0	2.05	33
Green peas	105	90	16.7	15.0	0.68	10
Beans	103	86	19.8	17.0	5.06	86

Per farm savings in transportation cost due to new roads was Rs. 2,717 per year. Based on the data, per hectare savings was Rs. 1,969 and saving for the entire benefited area was to the tune of Rs. 47.51 lakh per year.

#### *Savings Due to Reduction in Wastages*

Better road conditions reduced the wastages while marketing, which was reduced by 0.5 per cent in the case of garlic to 1.86 per cent in the case of carrot (Table 5). Perishability of carrot was very high especially during rainy season and reduction in wastage was substantial for it. Savings on this account worked out to be in the range of Rs.3.10 per quintal in the case of cabbage to Rs.22.10 per quintal in the case of garlic. Reduction in wastage on account of improved roads benefited the sample farms by Rs. 1,260 per year. The average benefit per hectare was Rs. 959 and total savings in the benefited area was Rs. 22.03 lakh annually.

TABLE 5. SAVINGS IN WASTAGES

Crops (1)	Damage on transmit for marketing (per cent total)				Saving in wastage (Rs.)	
	Pre- (2)	Post- (3)	Savings (4)	Value (Rs./qtl) (5)	Production /farm (qtl) (6)	Amount saved (7)
Potato	2.2	0.7	1.5	8.1	102.83	833
Carrot	3.4	1.9	1.5	6.5	50.41	328
Cabbage	2.5	0.7	1.8	3.1	8.02	25
Garlic	1.0	0.5	0.5	22.1	2.05	45
Green peas	2.5	1.5	1.0	12.0	0.68	8
Beans	2.3	1.5	0.8	4.1	5.06	21

### Gross Benefit from Farm Operation

From the foregoing discussion, it is clear that the farmers in the benefited area benefited by way of increased income owing to the change in the cropping pattern/increased gross cropped area, price gains, savings in cost of cultivation, reduced wastages while marketing and transportation cost. The details of gross benefit to the farm sector on account of investment in road in the benefited area are given Table 6.

TABLE 6. GROSS BENEFIT TO THE FARM SECTOR IN THE BENEFITED AREA

Savings/gains (1)	Benefit in farm sector (Rs./year)			
	Sample farm (2)	Per ha. (3)	Total benefited area (Rs. lakh) (4)	Share to total (per cent) (5)
1. Income gains due to change in crop area & pattern	1100	797	19.23	15.8
2. Income from price gain	1203	872	21.04	17.4
A. Total income gain	2303	1669	40.27	33.2
3. Savings in cost of cultivation(input transport)	660	478	11.57	9.5
4. Savings in transportation cost of output	2717	1969	47.52	39.1
5. Savings in wastages	1260	913	22.04	18.2
B. Total savings	4637	3360	81.13	66.8
C. Gross net income to farm sector (A+B)	6940	5029	121.4	100

The benefits accrued to the sample farm per year was to the tune of Rs. 6,940 from both income gains and savings in costs. These are the direct benefits to the farmers. Per hectare annual benefit was to the tune of Rs. 5,029. Gross net income to the farm sector was worked out to Rs.121.6 lakhs, two-third of which was from savings in cost of transportation, cost of cultivation (input transportation) and savings due to reduced wastages.



## IV

## ECONOMICS OF THE INVESTMENT

Net incremental income of the investment in road has been calculated as the difference between gross benefit accrued on account of the road and recurring cost of the road (maintenance cost and servicing of investment cost). Since a major part of the road passes through the forest and under the shade of trees, the road is subjected to damages, especially during rain. As improper/lack of maintenance accelerate the damages and reduce the life of the road, adequate provision has to be made to work out the economics of investment with sustainable benefit. Based on the estimate done by the Highways Department (Rural Roads), the annual recurring maintenance cost for the road was Rs. 41,840 per km and Rs. 3.00 lakh per km for re-laying of road once in five years. Hence, annualised recurring cost worked out to Rs. 1,01,840 per km and Rs. 19.96 lakh. The interest for loan (Rs. 463.77 lakh) under RIDF at 12 per cent was worked out to Rs. 55.65 lakh per year. By subtracting total annual recurring cost of Rs. 75.61 lakh from net income from farm sector at Rs. 121.6 lakh, annual net income from the investment was Rs.45.99 lakh.

Economic Rate of Return (ERR) of the investment was also worked out using shadow price for the labour component in the cost of investment, assuming 15 year life for the investment, 50 per cent of the realised benefit during the first year after completion of the investment and 100 per cent benefit from second year onwards and also assuming incremental benefit for incremental cost for the investment. The results of the study indicated the economic viability of the investment at 19.4 per cent ERR. Net present value of the net benefits of the investment at 15 per cent discount rate was worked out to Rs.95.6 lakh and Benefit-Cost Ratio of the investment was also good at 1.19 : 1.

## V

## CONCLUSION

The results of the study from the hilly region in Dindigul district indicated that the benefit to the farm sector was maximum in reducing transportation cost both for output and input in addition to reduction of wastages, price gain on marketing and income gain from shift in cropping pattern. However productivity gain, as observed elsewhere, was found to be absent in the study area under reference. The investment in rural road was considered to be economically viable only if the benefits accrued to the farm sector along with benefits to non-farm sector and service sector were taken into account. Though the improved connectivity unleashes a plethora of benefits to social sector, the benefits accrued to the farm sector alone are sufficient to justify the investment.

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