

An integrated and logistic approach to surface transport model: Some results for Odisha

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Abstract: The author's intention in present article is to focus properly the impact of some socio-economic indicators like agriculture, forestry, industry, mining, storage, fisheries, electricity, hotel, communication, real estate, construction, public administration, consumer price, total GSDP and other services over transportation by using mathematical models like simple correlation and regression.

Keywords: GSDP, PMGSY, Coefficient of determination – R^2 and Socio-economic indicators.

INTRODUCTION

Strategic transport planning has emerged as a critical input to State's success and has come in handy as a tool to deal with the uncertainties that state faces. It is presented in any situation where modeling has to be resorted to in order to provide a structured understanding of reality. An effective strategy capitalizes on the opportunities through the use of strengths and neutralizes the threats by minimizing the impact of weakness. For Orissanization, transport modeling for infrastructural development in roads and transport is essential as well as inevitable. Under globalization, liberalization, modernization and industrialization whims, the State Govt. has motivated to improve several socio-economic parameters like agriculture, fisheries, mining, industry, hotels, electricity, real estate, construction, communication, public administration, storage and other services [1]. The actual growth and development of above cited factors can lead to the growth of transportation sector of Odisha.

The socio-economic indicators can give sufficient lift for the overall upgradation of roads and transport in both rural and urban location of the State.

The analysis in present article is based on mathematical models [4][5], which are implemented in broader aspects in order to widen the scope of development in surface transport by the concrete and stable impact of some socio-economic indicators.

MAIN FOCUS

Development of roads and transport has been the priority of the government. One of the basic requirement for over all development of Odisha state is the existence of basic infrastructure such as roads that covers not only the length and breadth of the State but also affects the lives of all sections of the society and all sectors of economy be it agriculture, trade, industry or any other socio-economic indicators. To provide impetus to the development effort in Odisha State, the Ministry of Road Transport and Highways has undertaken a number of specific programmes to improve certain existing roads as well as to construct new roads in Odisha [1]. These programmes are also in addition to substantial investment being made by Central Government on upgrading of several State Roads through Ministry of Development of Eastern Region and construction of rural roads under Pradhan Matri Gramya Sadak Yojana (PMGSY) by Ministry of Rural Development [6].

RESULTS AND INTERPRETATION

The relationships as well as impact on transport by the selected socio-economic parameters have been presented in the following.

Table-1: Mean and Standard Deviation of transportation and allied aspects with some social parameters during the period from 2003-04 to 2012-13

Social Parameters	Mean	Std. Deviation
Transportation (Rs. In Lakh)	1141511.20	598623.78
Road Length (In Kms.)	2440.26	1341.80
Amount spent in Road (Rs. In Crore)	917.47	673.57
No. of Vehicles (In 000)	2314.81	688.09
Agriculture & Animal Husbandry (Rs. In Lakh)	2513458.40	961149.29
Forestry (Rs. In Lakh)	341347.00	83787.00
Fisheries (Rs. In Lakh)	172483.60	63959.46
Mining & Quarrying (Rs. In Lakh)	1399819.40	759168.63
Manufacturing units (Rs. In Lakh)	1879955.50	897408.71
Electricity, Gas & Water Supply (Rs. In Lakh)	377646.50	97613.81
Construction (Rs. In Lakh)	1368434.00	529561.15
Hotel & Restaurant Trade (Rs. In Lakh)	1760100.20	898683.65
Storage (Rs. In Lakh)	15302.00	8551.02
Communication (Rs. In Lakh)	149768.10	61709.34
Banking & Insurance (Rs. In Lakh)	490424.70	260188.39
Real Estate (Rs. In Lakh)	856150.50	378146.79
Public Administration (Rs. In Lakh)	620812.90	296440.90
Other Services (Rs. In Lakh)	1441740.40	693536.10
Total GSDP (Rs. In Lakh)	14405854.40	6427863.16
Population (In Lakh)	403.47	16.19
Consumer Price Index	400.38	83.57

(Source of data- Economic Survey of Odisha 2012-2013)

Table-1 above presents the mean and standard deviation (SD) of transport and allied aspects and some social parameters of Odisha state during the period 2003-04 to 2012-13 [3]. The figures for transportation, length of roads constructed, amount spent in road construction and number of vehicles are in lakh, kms, crore and thousand respectively where as the same for social parameters are in lakh. On application of reliability analysis to the considered data, the Cronbach's Alpha has been calculated as 0.748 which signifies the adoptability of the data for further analysis [2].

Table-2: Correlation between transportation and allied aspects with some social parameters

Social Parameters	Total Transport	Road Length	Amount spent in Roads	No. of vehicles
Agriculture & Animal Husbandry	0.696	0.872*	0.897*	0.903*
Forestry	0.689	0.883*	0.840*	0.952*
Fisheries	0.735*	0.851*	0.822*	0.913*
Mining & Quarrying	0.735*	0.877*	0.861*	0.908*
Manufacturing units	0.745*	0.808*	0.822*	0.902*
Electricity, Gas & Water Supply	0.718*	0.380	0.294	0.545
Construction	0.778*	0.849*	0.856*	0.916*
Hotel, Restaurant & Trade	0.790*	0.861*	0.845*	0.919*
Storage	0.764*	0.831*	0.812*	0.915*
Communication	0.761*	0.859*	0.836*	0.914*
Banking & Insurance	0.747*	0.838*	0.804*	0.901*
Real Estate	0.752*	0.851*	0.824*	0.921*
Public Administration	0.726*	0.851*	0.845*	0.915*
Other Services	0.734*	0.890*	0.879*	0.910*
Total GSDP	0.758*	0.869*	0.863*	0.922*
Population	0.779*	0.877*	0.878*	0.919*
Consumer Price	0.549	0.917*	0.925*	0.916*

N.B.: - GSDP – Gross State Domestic Product, * - Significant at 5% level ($P < 0.05$)

Table-2 presents the correlation coefficients between the transportation and allied aspects with some social parameters, The correlation coefficients more than 0.71 are significant and have been marked with “*”[3]. Accordingly, agriculture and animal husbandry is weekly correlated with transportation but significantly correlated with road length, amount spent in road construction and number of vehicles. Similar trend is observed in case of forestry and consumer price. But the contrasting trend is observed in case of electricity, gas and water supply. But in other social parameters like fisheries, mining and quarrying, manufacturing units, construction, hotel and restaurant trade, storage, communication, banking and insurance, real estate, public administration, other services, total GSDP and population are significantly correlated with transportation as well as allied aspects [1]. Although it establishes acceptable linear relationship between selected social parameters with transportation and its allied aspects, still it is of further inquisitiveness to look for the best suited mathematical relationship. Since all the correlation coefficient are positive, it indicates one increases when the other increases. Here, transport has been taken as the dependent variable (Y) and social parameters have been taken as in independent (X). Now the data have been put to the following mathematical models for the cited purpose [9-10].

Linear	$Y = C + a_1 * X$	(1)
Quadratic	$Y = C + a_1 * X + a_2 * X^2$	(2)
Cubic	$Y = C + a_1 * X + a_2 * X^2 + a_3 * X^3$	(3)
Logarithmic	$Y = C + a_1 * \ln(X)$	(4)
Inverse	$Y = C + \frac{a_1}{X}$	(5)
Compound	$Y = C * a_1^X$	(6)
Power	$Y = C * X^{a_1}$	(7)
Growth	$Y = e^{C+a_1*X}$	(8)
Exponential	$Y = C * e^{a_1*X}$	(9)

Equation	Mathematical Expression
Linear	$Y = C + a_1 * X$
Quadratic	$Y = C + a_1 * X + a_2 * X^2$
Cubic	$Y = C + a_1 * X + a_2 * X^2 + a_3 * X^3$
Logarithmic	$Y = C + a_1 * \ln(X)$
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Exponential	$Y = C * e^{a_1*X}$

N.B:- Y = Transport and X = Social Parameter,
C = Constant, a_1, a_2, a_3 = Coefficients

Table 3 presents all the R^2 -values are more than 0.5, except consumer price value and it indicates more than 50% of the data in consideration is explained by the cited mathematical models arising out of different regression equations cited above (i.e., E_1 to E_9) [6-7]. Thereby the obtained mathematical relationship between transport and some socio-economic parameters are acceptable. This indicates acceptable impact of the cited socio-economic indicators over transport in the form of mathematical relationship mentioned in Table-3. The variation in each socio-economic indicator will give variation in transport in the form of mathematical equations mentioned against each. This conforms to the trend of correlation existing between two in every case. Taking the available figures on transport and social parameters from 2003-13 into account, the future may be forecasted by referring the mathematical equations in Table-3 [8].

Table 3 : Mathematical relationship between transportation (Y) and some social parameters (X) during the period 2003-04 to 2012-13.

Social Parameters (X)	Mathematical Equation	R ²
Agriculture & Animal Husbandry	$Y = 0.029 * X^{1.183}$	0.574
Fisheries	$Y = 0.170 * X^{1.298}$	0.616
Mining & Quarrying	$Y = 12.647 * X^{0.805}$	0.678
Manufacturing units	$Y = 1.961 * X^{0.916}$	0.698
Electricity, Gas & Water Supply	$Y = 0.001 * X^{1.662}$	0.532
Construction	$Y = 0.025 * X^{1.244}$	0.732
Hotel & Restaurant Trade	$Y = 1.091 * X^{0.962}$	0.751
Storage	$Y = 200.651 * X^{0.895}$	0.691
Communication	$Y = 0.470 * X^{1.229}$	0.656
Banking & Insurance	$Y = 5.002 * X^{0.939}$	0.621
Real Estate	$Y = 0.215 * X^{1.130}$	0.631
Public Administration	$Y = 1.174 * X^{0.999}$	0.568
Other Services	$Y = 1.015 * X^{0.979}$	0.620
Total GSDP	$Y = 0.022 * X^{1.076}$	0.681
Consumer Price	$Y = 6.243 * X^{1.978}$	0.492

R²- Coefficient of Determination, The highest value of R² has been considered only.

CONCLUSION

It is concluded from above analysis that each socio-economic indicator except consumer price has significant impact on transport during the period 2003-13. As it is envisaged the development in each socio-economic indicator has considerable effect on the transport for development. Hence, the augmentation of each social indicator has caused the development in transport system.

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