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Public Utility Characteristics of Railways in India

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To serve Indian economy railways carry different category of freight traffics like coal, iron ore, food grains, steel, fertilizer and mineral oil, etc. Dispersal of some of these freights is limited compared to other traffics which ambit of outreach is quite large. Food grains and fertilizers are such freights which reach wider section of population, transporting thereby railways carry off its public utility responsibilities. From this perspective, public utility characteristics of railways in India is attempted to study by analyzing the trend and pattern of aggregate freight flow, particularly food grains and fertilizer traffic for the study period 1965-2014 with special reference to region served by North Eastern Frontier Railways (NEFR).

1. Introduction

In order to carry out transport obligations, Indian Railways (IR) carry a wide range of diversified commodities. These freights may be classified from different purposes it serve as well as from different perspectives, classifications can be made. Rail carried commodities may be divided into inputs and outputs, agricultural and industry specific goods, fuel and non-fuel as well as solid and liquid traffic. Basic task entrusted with IR is to serve long-distant corners of Indian economy at low cost of service provision. These traffics may also be classified on basis of extent of reaching out to area, people and particularly needy people through systematic delivery of goods and services. Inputs to iron and steel industries, its outputs, petroleum, mineral oil are such traffics carried by railways which serve higher end of people, limited areas and specific sectors while other hauled freights like coal, food grains and fertilizers at very low cost go to immense benefit for poor people to have at long distant part and regions of Indian economy through public distribution system (PDS), Food grains Corporation of India (FCI) and rationing arrangements. Coal transported by IR is used for varied purposes. Coal is used as fuel both by people and industrial sector. Presently, use of coal for public purposes (washeries and others) lost its significance for carriage and as an industrial input traffic (steel and thermal power plants), coal use and its transportation by IR holds the most pre-dominant carriage purpose and destination. According to Indian Railways Annual Statement (IRASS), originating and terminating coal freight hauled by railways for washeries and other purposes were 73 % and 89 % respectively in 1965-66 but came down to about 24 % in 2013-14 [1-3]. Presently, food grains and fertilizers, particularly food grains traffic is one of the most important such hauled traffic which serve needy and poor people of not only of agricultural classes. From this perspective, public utility characteristics of IR becomes evident - carry goods and services not only at low cost casting diminishing impact on inflationary trend through lowering input cost

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but also reach to mass population and satisfy daily needs. In views of Ghosh [4] railways since a public enterprise, for all freights freight rate should not be charged on basis of what traffic can bear, rather keeping in mind essentiality of item, agricultural and industrial development of country, this need to be fixed at lower rates thus incurring financial losses in national interest. Total losses on movement of essential commodities amounted to 41.20 crores in 2015-16 [5]. He further opined that freight equalization was also partial in laying a foundation behind fright rate determination by maintaining that industrial location away from resource prone areas was required for sound utilization of human resource in other parts of country but not applied to coal freight, thereby leading to preference of industries in Nagpur mines for Karanpura fields over Bengal mines.

2. Backdrop

Before Independence, Indian economy was mainly driven by colonial masters and their constructed railways predominantly served link among tea plots, cotton sector and port lands. Whatever public utility characteristics of railways may be thought of at that time were mainly a bi-product of this portward movement and reverse flow. This was in very construction of railways which followed cheaper freight rates on lines radiating ports [6]. However, after independence railways construction was utilized as well as extended for serving mainly domestic economy and port oriented traffic became secondary in importance [7]. In agricultural sector, self-sufficiency is found to be prevailing in Indian economy from 1970 onwards, particularly from time of First Green Revolution (GR) of mid-1960s. Before that, food grains were imported from foreign countries as per requirement; even USA supplied for food deficiency under PL 480. Therefore, public utility characteristic of IR can be found at both directions, port traffic and inland oriented in terms of food grains carriage up to 1965-66. After success of Green Revolution, food grains traffic hauled by IR lost its port oriented significance and its carriage became the most important for fulfilling its public utility responsibility. Estimation from *IRASS* shows that aggregate freight origination became higher from 24.34 % in 1965-66 to 29.49 % in 2013-14 for the region served by Central and Northern railways but this shrunk for the port oriented areas served by Eastern, Western and Southern railways while aggregate freight termination although increased from 32.32 % to 35.35 % over the study period in former regions. This remained intact around 66 % in latter areas. For food grains traffic these statistics become more distinct as originating freight increased in former region from 37.19 % to 64.51 % over same period, in the port served areas railways originating freight share became lower from 66.57 % to 35.49 % while traffic termination share improved for latter region from 32.82 % to 78.08 % showing food surplus dispatch, although food grains termination share was reduced from 54.90 % to 26.88 % in former regions during concerned time-period, again showing a sign of food self-sufficiency achieved over the years. At that point of time, success of HYV seeds and chemical fertilizers were limited to basically Punjab, Haryana, Gangetic and Eastern part of India, therefore to provide food grains supply to corners of vast sub-continent size of India, railways were necessitated to shoulder this public utility concern. Afterwards having learnt lessons from concentrated success of Green Revolution, agricultural decentralization was pursued. Leaving some barren regions, zigzag topography, shifting cultivation prone areas and fallow land, agricultural extension, both intensive and extensive became a reality and consequently long-distance transportation needs of food grains by railways gradually got diminished, according lower role that this mode of transportation played from public utility viewpoint. Indian Railways felt further lower thrust to carry food grains at large scale and lower cost due to Indian economy adopting globalization and liberalization policy under structural adjustment program, resulting in shrinkage of public sector investment, withdrawal of PDS and rationing arrangement. A consequence as well as another factor behind food grains traffic not being encouraged to be rail bound is its rising tariff rate of carriage compared to other category of freights**.** Over study period 1965-2014, railways freight rate increase on aggregate is found to register 7.3 % compound annual growth rate (CAGR), for pig iron and finished steel from steel plants, raw material to steel plants and cement freight, these were 7.45, 6.95 and 7.16 CAGR respectively whereas for food grains and fertilizer railways charges of one tonne haulage over one

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kilometer increased at an annual CAGR of 7.58 and 7.76 respectively (IRASS). Loading and unloading of such traffic also became subdued over years, which made per unit transportation costlier in terms of average carriage rate to compensate for total cost of haulage. While annual CAGR of railways aggregate freight loading and unloading made an increasing trend from 1.2 % in 1965-78 to 5.73 % in 2002-14, that of food grain found to make opposite trend in downward movement from 2.35 % and 7.44 % respectively in 1965-78 to 1.59 % in 2002-14 (IRASS*)*. However, according to Bibek Debroy Panel, recent increase in railways general earnings has been mainly driven by higher freight rates than considerable increase in volume.

3. Agricultural Viewpoint

Another utility IR serve is for industrialists. From second five year plan Indian economy thrived strongly for industrialization, mainly related to basic and heavy industries. But similar to limited spread of GR, these industries were concentrated at certain regions like Villai, Rourkela and barrier of long distant weighty haulage was overcome through railways in smoothly shifting raw materials form mines. However, these industries were not necessarily set up in resource prone areas and states, in fact some of these were great distant from mining areas, these were covered by railways and freight equalization policy of Government played a very important role in this respect. For some freights like coal, railways followed steeply taper off rates below marginal cost coverage over 300 miles carriage facilitating redistribution of industries away from regions where coal and mineral resources were located and this concession was supposed to outweigh high cost of finished output delivery to nearby consumption centers of shorter distance [8]. Actually, food grains and cotton cultivation were followed in northern and eastern part of India by blessings of river Ganges, Himalayan monsoons and fertile alluvial soil as well as in southern part by black soil, so had some type of scope for further development on basis of progress achieved in agricultural sector and its connected regions whereas southern states like Karnataka had no such opportunity for development but there were millions of heads to work and mouths to feed [9]. That made a logical plea to development policy makers in implementing tapering off and equal per unit freight carriage rates hauled by railways in order to encourage industrial development in those regions by employing easily available labor pool and thus solving all problems of lower revenue generation, unemployment and lop-sided development of Indian economy simultaneously. Even presently in absence of railway connectivity with coastal ports of Karnataka due to abrupt topography of in-between hilly and forested Western Ghat, raw material mainly iron ore approach different eastern coast ports via road network leading to pollution and higher transportation cost, thus languishing industrial and overall development, related employment opportunities in dry northern hinterland of this state [10]. Later on idea of industrial decentralization was accorded tremendous significance for removing regional disparity but it was confined to small-scale industries and large-scale industries were mainly founded in regions already having those concentration. This pattern did not change that much over time. Naturally, industrial decentralization did not impact railways utility characteristics to the extent caused by that of agricultural decentralization, made possible through application of HYVs and bio-chemical fertilizer on intensive and extensive cultivation of arable lands. As a result, bulk carriage of industrial inputs and output was maintained and this became a permanent feature for IR. Naturally, growth of average carriage rate for industrial inputs was lower relative to that of agricultural commodities**.** However, industrial development of Indian economy would have been faster and stronger impact could have been exercised on regional dispersal if freight equalization policy was implemented both ways, for supplying iron ore, coal inputs to remote industrial establishments as well as for bringing iron and steel output from such factories to potential and prospective sites of industrial commodity consumption. At the same time this should have facilitated acceleration of Indian industrialization by enhancing affordability for low income households although at the expense of change in pattern of location of such industries from eastern India to its southern parts and setting up of related engineering and other ancillary industries over there, leading to reduction in absorption of labor pool in such avenues for eastern India and consequent migration. Accentuation of this

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industrial relocation pattern may be very easily anticipated after the country adopted Structural Adjustment Programme (SAP) under GAL process of 1990s. Compared to agricultural decentralization, impact on railways that of industrial development under GAL process to effect would be lower as private industrial set-up in search of profitability usually established units and joint ventured in such places where already necessary infrastructure is present in good working condition and providing returns, thus keeping intact distance needs of transportation for railways to fulfil. However according to NCAER [11], railways freight share may reduce further thus its role in transportation as industrial units being increasingly set up near raw material sources in addition to general hike in freight rates raised for cross-subsidization of passenger segment.

4. North East Concern

Indian economy is known by unity in diversity that exists not only in culture, occupation status and water network but also in geographical differences of different regions. Based on these IR public utility characteristics may also obtain regional dimension. At one side there is desert, coastal landscape and river concentration over plain regions while at other side Himalayan wings and steep gorges along with torrential rivers form geographical base. Northern India is surrounded by Himalayas, although majority of river networks lie in northern and southern India, the extent to which inter-modal networks of road, railways and water can be accessed in most part of vertical and peninsular India, is not possible in every part of its northern half. Naturally, inter-regional connectivity is easily accessible in mainland India compared to its north eastern part. From this perspective agricultural decentralization's impact on diminishing railways public utility carriage would be more in mainland states as these states can easily harness opportunity of freight haulage by river and road sectors, particularly through golden quadrilateral to transport food grains traffic from nearby centers of originating and terminating regions. It would be difficult for north east region to develop such alternative modes of transportation easily on abrupt terrain and rivulets further aggravated by existing problems of insurgency, road blockage and thus continue with railways for mass transportation via Assam as the main hub of North East Frontier Railway. Keeping in mind scattered thin population, low level economic activity in mostly hilly region, dis-functionality of Brahamaputra and Barak river system after partition, expensive air and road connectivity due to costly bridge building over small rivulets and difficulty in road building material transportation, further exacerbated by frequent blockades, bandhs, landslide, flood and seismic occurrences, there is recommendation in GOI [12], to emphasize railways building for aggregating low per capita output over long distance to carry bulk freight at low cost as well as to develop hub and spoke model with hubs at Guwahati, Imphal and Agartala along with construction of multi-modal points at Dhubri and Badarpur. This may be facilitated by six percent concessional grant given in railways for all freight consignments booked at North Eastern region (Chapter 1: Freight and Wagon Management on Indian Railways) [13]. Apart from jhum cultivators particularly tribal people led ecologically adverse shifting production, residents of North Easterners mainly rely on permanent cultivation generating marketable surplus which transaction success inevitably depends on low cost smooth bulk transportation provided by railways compared to hazards of road building over undulating topography like frequent landslides, floods and insurgent road blockage that build inflationary thrust on market price of transacted commodities due to low volume carriage. This may be a factor behind public utility characteristic of NEFR through chicken neck Siliguri route at divergence from its trend in other zonal railways of Indian economy, in fact this may increase over time when all capital cities of North East India (NEI) become rail connected and get opportunity of low cost bulk transportation, which is not otherwise economically feasible and technologically possible over zigzag terrain of North Eastern part of India.

5. Empirical Findings

Net tonnage kilometer per route length (NTKMRL) may serve as an indicator for understanding the extent to which railways playing its role in mobilizing freight flow in Indian economy and its different regions.

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Glimpse of that can be visualized from the figure 1 (a) and 1 (b). These figures depict that route freight density mobilization is increasing in both aggregate and disaggregate regions served by IR and NEFR for total and broad gauge (BG) carriage with diminishing role for meter (MG) and narrow gauge (NG) over the years. However, for NEFR this density is approximately half to aggregate in totality, BG and MG considerations and there are fluctuations in trend, not strictly monotonic.

Relative NTKM (food grain NTKM expressed as ratio to aggregate freight NTKM) may serve as an indicator for conceptualizing comparative role of railways in carrying commodities of daily necessities over the study period, implying its performance on fulfilling public utility characteristics. Figure 2 (a) and 2 (b) are related to IR and NEFR relative NTKM of food grain traffic. From Figure 2 (a) it may

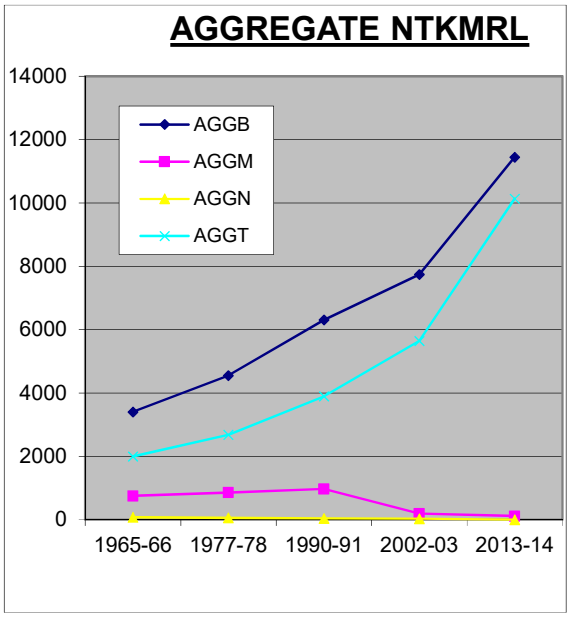

Fig. 1(a)

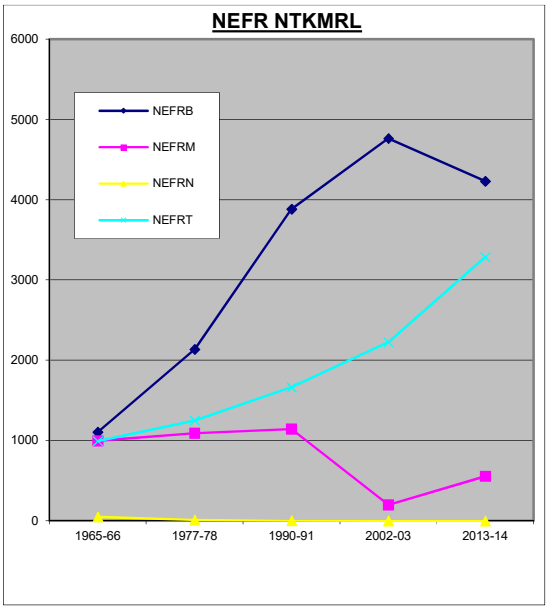

Fig. 1(b)

Figure 1. Net tonnage kilometer per route length (NTKMRL) for Indian Railways

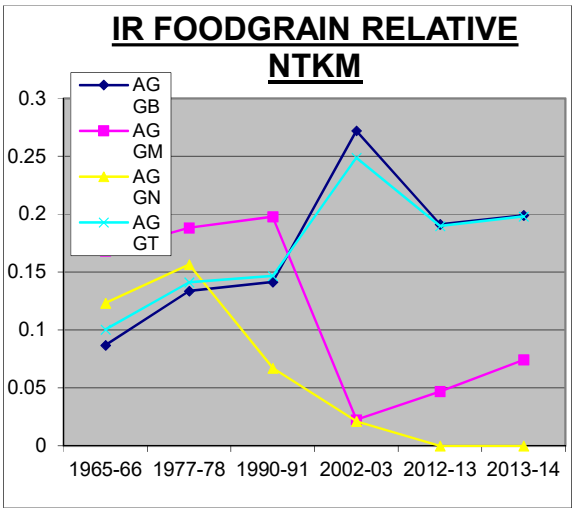

Fig. 2(a)

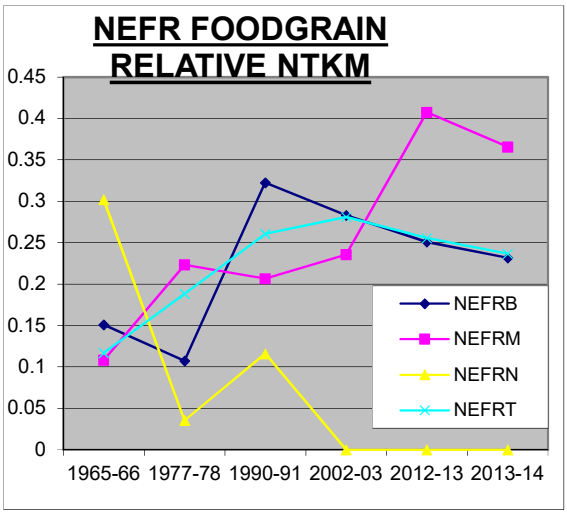

Fig. 2(b)

Figure 2. Relative NTKM (food grain NTKM expressed as ratio to aggregate freight NTKM) for Indian Railways

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be noticed that public utility role of IR in hauling food grains freight after increasing from 1965 to 2002 started declining both at total consideration and BG network while for MG and NG networks, relative food grains NTKM diminished from 1980s and 1970s, respectively. For NEFR, Figure 2 (b) shows that railways role to serve general people after rising slowly upto1990-91 started to fall both at totality and BG consideration whereas NG transportation registered a strictly monotonic decreasing trend on relative terms over the years.

One clear deviation to IR may be observed in respect of relative MG haulage which is found to make an increasing trend for the period 1965-2014 and this implies even though public utility characteristics of railways through maintaining relative food grains freight mobility diminished after 1990-91 in the areas served by main lines of BG network, that of branch lines served remote corners of NEI with small scattered habitations had been experiencing its improved performance.

Figure 3 (a) and 3 (b) stand for relative NTKM of fertilizer traffic carried by IR and NEFR, respectively. With little fluctuation, like food grains freight similar performance can be noted here for IR and NEFR in respect of MG and NG networks. However, on totality and BG considerations, differentiation between IR and NEFR becomes evident where for IR these are found to draw monotonically increasing trend to roll over relative fertilizer mobility, for NEFR these register mildly downward pattern.

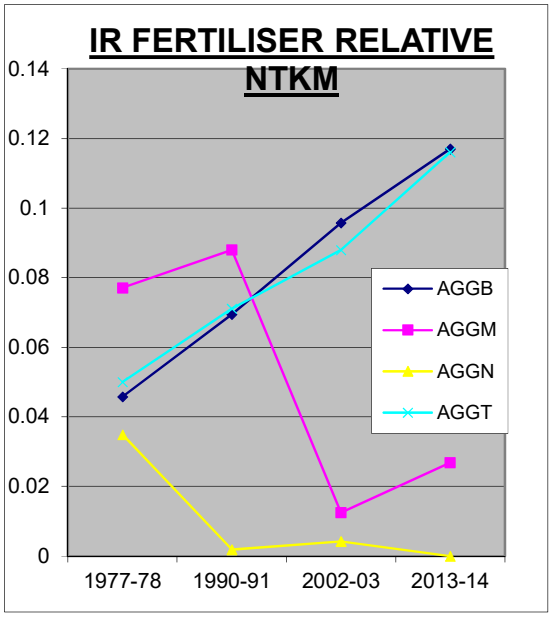

Fig. 3(a)

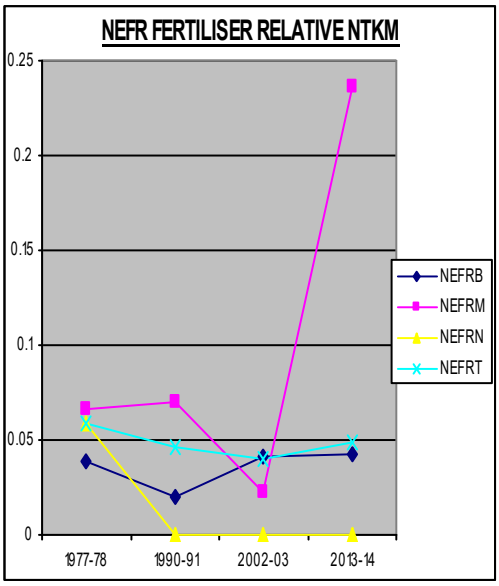

Fig. 3(b)

Figure 3. Relative NTKM of fertilizer traffic carried by IR and NEFR, respectively

To analyze empirically role of IR in transporting all frights and particularly food grains, fertilizer of frequent requirements over aggregate space and disaggregate NEFR served areas since 1966, following statistics from IRASS on BG, MG and NG were considered.

NTKM----------Net Tonnage Kilometer
AVGLD ----------Average Lead
AGCW ----------Covered Wagon
AGW ----------Wagon
TCRN----------Tonnes Carried
AGORG---------Originating Traffic
AGTRT -------- Terminating Traffic
AGOT -------- Originating + Terminating Traffic
AVGRT ----- -- Average Rate
RL ---------- Route Length
RU ---------- Running Track
FRL-ARL----- Difference of Food grain NTKM Per RL
FRU-ARU-----Difference of Food grain NTKM Per RU
FTRL-ARL---- Difference of Fertilizer NTKM Per RL
FTRU-ARU--- Difference of Fertilizer NTKM Per RU

NTKM, AVGLD, AGCW, AGW, TCRN, AGORG, AGTRT, AGOT and AVGRT were expressed in relation to RL and Generalized Linear Modelling (GLM) was applied for total freight volume hauled by aggregate IR and NEFR separately. Table 1 shows gauge effect is

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significant (95 % Wald Confidence) for railways since earlier time (1965) to 2014. For NEFR, positive effect of MG and NG network is estimated with BG casting negativity while for IR role of BG network in aggregate freight transportation turning out to be significant with negative role.

Table 1. NEFR Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval	
			Lower	Uppe
Intercept	.379	.1360	.113	.646
[BG]	-1.034	.3490	-1.718	-.350
[MG]	-.104	.1645	-.426	.218
[NG]	0	.	.	.
AVGLD	.211	.0962	.022	.399
AGCW	-.565	.1437	-.847	-.284
AGW	.589	.1278	.339	.840
TCRN	1.360	.4384	.500	2.219
AGORG	-.257	.1366	-.525	.010
AGTRT	-.172	.3057	-.771	.428
AGOT	0	.	.	.
AVGRT	-.242	.1058	-.449	-.034
Scale	.009	.0033	.004	.019

Casting for those of MG and NG for IR NTKMRL is found to make ascending trend and for NEFR this makes faster rise, Table 2. Again from above GLM, it is found that for IR only carriage of AGCW and AGORG playing important role in increased role of railways transportation while for NEFR, more intensified role of railways may be the aggregate strength all concerned variables coefficient except freight termination generating (becoming significant) and giving a larger push in its haulage.

Table 2. IR Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval	
			Lowe	Upper
Intercept	-.038	.0320	-.100	.025
[BG]	.076	.0705	-.062	.214
[MG]	.036	.0411	-.044	.117
[NG]	0	.	.	.
AVGLD	-.013	.0134	-.039	.013
AGCW	.054	.0138	.027	.081
AGW	.014	.0181	-.022	.049
TCRN	-.507	.3552	1.203	.189
AGORG	1.442	.5825	.301	2.584
AGTRT	.012	.5405	1.047	1.072
AGOT	0	.	.	.
AVGRT	-.012	.0177	-.047	.022
Scale	.001	.0004	.001	.002

For evaluating role of railways in food grains and fertilizer transportation, those variables were expressed in terms of contribution to aggregate freight haulage. In case of food grain carriage, different result is obtained. Although for IR gauge effect could be estimated, for NEFR there exists no such effect. Food grains haulage by IR is found to be positively significant for BG and MG network in descending sequence and negative role being played by network of NG. Although this freight carriage increased proportionately in BG track, importance of MG and NG tracks became diminished gradually but for NEFR increasing role of MG track in food grains transportation did exist. So expected variation in impact of causal variables in this framework can easily be noticed and this shows significant role of proportionate AVGLD, AGORG, AGTRT, AGOT, FRL-ARL and FRU-ARU for NEFR while for IR only proportionate TCRN, FRL-ARL and FRU-ARU are found to turn important.

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In case of fertilizer carriage better result is derived in this model. Almost all concerned variables turned significant with differentiation between aggregate and disaggregate role of railways in freight haulage. In both spaces significant gauge effect exists, for NEFR positive role is casted on NG network with negative aspects on BG and MG network while for IR relative fertilizer transportation is positively significant on BG and NG network in ascending sequence with diminishing role found to be played by MG network. However, gauge wise relative fertilizer NTKM shows increasing trend for IR in BG tracks and a downward movement in MG and NG tracks although for NEFR fertilizer transportation in this respect registers increasing trend over MG network which stands for greater coverage made possible by railways at distant corners of this region. Consequently, estimation of relative average lead is showing positive impact for NEFR while reducing distance can be noted in negative coefficients for IR. Similar impact is estimated for relative tonnes carried. In respect of FRL-ARL and FRU-ARU, opposite results are obtained between IR and NEFR with positive sign of FRU-ARU and negative sign of FRL-ARL for NEFR. This implies that railways transportation increased spread of fertilizer traffic in NEFR with reduced intra-regional concentration and for IR railways role in terms of outreach mobility had been lower getting concentrated in few areas. Another deviation is found in respect of relative rate (cost) of transportation with negative coefficient for NEFR and positive score for IR, which means increasing average rate of fertilizer carriage relatively even though may not pull its mobility backward over aggregate space, in fact leads to increase but for NEFR this certainly would have led to reduction in fertilizer NTKM relative to aggregate freight flow keeping in mind that fertilizer consumption is usually low in this region. Among remaining considerations, relative originating and terminating fertilizer traffic are depicted to be casting positive impact in both these spaces while importance of covered wagon carriage is found to shrink in relative terms. Surprisingly, although relative tonnes carried of fertilizer make positive impact on fertilizer mobility in NEFR this casts negative influence in IR, may be due to diminishing average lead.

6. Conclusions

For IR on aggregate, freight transportation and public utility characteristics are found to be gradually shifted from MG and NG networks to BG network as BG network was extended and gauge conversion took place whereas for NEFR with increase in proportionate BG tracks although freights shifting took place at relatively slower rate, that of MG and NG networks importance in carrying off haulage responsibilities had not become shrunk, for MG tracks in fact increasing freight density is found to roll over along with serving enhanced public utility concern. This phenomenon may further be intensified in NEI if necessity of food grains and fertilizer imports from other railways zone become reduced on account of declining demand from marketable surplus generated due to gradual abandoning of environmentally adverse jhum cultivation in favor of settled agriculture and its capital cities become rail connected bestowing more importance to small scattered habitats served initially through branch line of MG and NG networks.

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