

## **Analysis of Trade and Operational Efficiency of Ports in India**

**\*U. Iyayarasan<sup>1</sup> and \*\*Dr. K. Jayaraman<sup>2</sup>**

\*Ph.D., Research Scholar and \*\*Associate Professor

Department of Economics,

Periyar University, Salem-636011.

**ORCID ID:** <https://orcid.org/0000-0002-7659-3282>

### **Abstract**

This study is an attempt to assess and evaluate the operational efficiency of Major Ports in India. A comparison Indian Major Ports to that of the Minor ports is taken into consideration. Various indicators are taken into account while evaluating the ports. Sea ports are a key system which prompts export improvement and financial advancement. As per the Review of Maritime Transport 2019, the responsibility of non-industrial nations towards the international trade is around 40%. India is in the sixteenth position for its maritime system. Nevertheless, India's seaport execution is well underneath the benchmark of international proficiency. Subsequently, ports have to work with the operational efficiency and it has to be analysed. As per the results among thirteen major ports, seven ports execution is apparently extending yet inefficient with their present system and various ports are profitable ports. Hence the ideal utilization of the system is needed for economic advancement of the nation.

**Key words:** Major Ports, Data Envelopment Analysis, Operational efficiency, Traffic

### **Introduction**

Globalization of world economy has witnessed major changes in transportation industry and item trade. The ports have long gestation time for organizing and more cash expenses. During 2014, a huge on the harbors of world most elevated level ocean ports of Asia and America have witnessed traffic blockage. In this way, the nations have evinced interest in sophisticating their ports to work on the functional viability through mechanization and International Maritime industry. India is one of the best peninsular on earth. 13 major ports and 187 minor ports are having contact with the world ports. The Eastern and Western shorelines house 7 and 6 ports respectively. The advancement in Indian ports is appreciable. The assistance of outside endeavors has announced that the breaking point usage through 201415 was around 66 rate and the turnaround period of 2.11 days which require only hours in various making economies. This shows robust side of Indian ports, but its efficiency share was 1.7 percent in the total global throughput. This is well below the international standards.

### **Review of Literature**

**Jose L. Tonzen (1994)** utilized an approach to select a port based on execution and capability. The two elements considered are terminal viability and port execution frameworks. The study pointed out about as terminal capability factors such as basic ally of work on the port presentation. Factors such as monetary development, geographical region

and repeat of vessel influence the work.

**Patrick Fourgeau (2000)** insinuated the World Bank report which has described the fundamental technique for assessing port presentations by laying out specific basics like usage of port supplies. It comprised of cranes and quay exercises related to working typical turnaround time and period of shipping various segments considered are dry mass, break mass, liquid mass and containerized payloads. It is used for assessing the work of quay.

**Marlow P. likewise, Paixao.A (2002)** adopted the Data Envelopment Analysis to study and Japanese ports. The port of Tokyo was consistent in its operation ports of Yokohama, Kobe and Osaka did not perform well. The ports data and yield factors evidently portrayed the adequacy which took after the earlier examinations.

**George Kobina van Dyck (2015)** used DEA model to study 6 important west African ports. The yield variable was throughput at compartment levels. The factors such as terminal district, cranes, the available yards and the length were considered in the study. The port of showed 76 per cent of capability the three ports were resourceful and efficient.

**Elijah Musango Munyao et al (2019)** the advancement of inland payload dispersion organizations has been a working way of managing help the hinterlands of ocean entries among various limits. This review presents an overall analysis about Chinese dry ports and nations in West Africa.

**Claudio et al (2020)** estimated the efficiency levels of 10 major ports in Europe. This hypothetical concept shows that the utilization of the stochastic outskirts investigation (SFA) and of the information envelopment examination (DEA). The procedures are used for benchmarking and execution assessment by including markers dependent on information from National Accounts. On the off chance that one of these pointers, for example, workforce consistency, isn't accessible at a particular degree of total, definite presumptions will avoid complexity. This model helps in analyzing the efficiency of ports at ease.

### **Statement of the Problem**

Water Transportation remains the less cost transport. The road transport imposes a substantial cost on the economy due to congestion, energy consumption and environmental pollution. Its share is significantly less than that of transports in developed countries. An environmental concern is essential for maritime transport and ports. Environmental regulations affect the shipping industry and viable technologies need to be explored for sustainable economic growth of a nation. Operational issues such as breakdown of cargo handling equipment often, outdated low productivity, insufficient and improper dredging and container handling facilities. Inefficiency creeps in due to the non-optimal utilization of port equipments.

### **Objectives**

- ❖ To study the efficiency of the major ports in India by investigating the exhibition of major sea ports during 2004-05 to 2018-19 dependent on the performance indicators.
- ❖ To investigate whether size is influencing the operational efficiency of major ports in India.

## Methodology

The current review depends on relevant information which was gathered from the port specialists. The functional work of Indian major remains remarkable. The performance of major ports related to traffic handled both compartment and vessels are studied. The data from 2004-05 to 2018-19 has been considered in this research work.

## ANALYSIS

### Shipping and Port Operations in India

More than 90 percent of India's complete exchange volume (77 percent as far as worth and 97 percent of its international exchange volume) is carried out through sea. The Indian is situated between the Atlantic Ocean in the west and the Pacific Sea in the east, with a 7000 km long coastline, and 12 significant and 205 operable minor furthermore, middle ports. The 12 significant ports took care of about 75 percent of port traffic in 2018-19. Despite the fact that most significant ports handle holders, just 7 are thought of as significant compartment ports. The Indian shipping industry was during the controlled economic also. This industry is housing few medium and large-scale shipping companies. The private players carry out around 80 per cent of the external trade of India. As India imports more crude oil, it has led to the emergence of more crude oil and gas carriers.

### Total Traffic by All Ports

The Table 1 shows the traffic handled of by major and minor ports in India during the time of study. The major ports handle more traffic when contrasted with non-major ports. The non-major ports also involve in more traffic quite a long time after year and came to 22.81 percent during 2018-19, uncovering that the non-major ports are additionally performing on par to major ports and the major ports limit utilization is reducing step by step which is to be tended to right away.

**Table 1: Traffic Handled by Major and Non-Major Ports in India**

Year	Major Ports (In MT)	Non-Major Ports (MT)	Total	Share of Major Ports	Share of Non- Major Ports
2004-05	383.75	137.83	521.58	73.57	25.57
2005-06	423.56	145.53	569.09	74.43	25.57
2006-07	463.78	186.12	649.90	71.36	28.64
2007-08	519.31	203.62	722.93	71.83	28.17
2008-09	530.53	213.20	743.73	71.33	28.67
2009-10	561.09	288.86	849.95	66.01	33.99
2010-11	570.03	314.85	884.88	64.42	35.58
2011-12	560.13	353.02	913.15	61.34	38.66
2012-13	545.79	387.87	933.66	58.46	41.54
2013-14	555.50	417.13	972.63	57.11	42.89
2014-15	613.54	451.21	999.29	65.23	34.77

2015-16	632.12	484.17	1029.03	67.04	32.96
2016-17	650.70	517.13	1058.77	70.42	29.58
2017-18	669.28	550.08	1088.51	73.81	26.19
2018-19	687.86	583.04	1118.25	77.19	22.81
$\bar{x}$	557.80	348.91	870.36	68.24	31.71
$\bar{x}.Dev.$	64.32	126.98	155.33	5.07	5.13
<b>MAX</b>	687.86	583.04	1118.25	77.19	42.89
<b>%P50</b>	560.13	353.02	913.15	70.42	29.58
<b>MIN</b>	383.75	137.83	521.58	57.11	22.81
$\sigma$	84.18	144.97	182.95	5.84	5.90
<b>CV</b>	0.15	0.42	0.21	0.09	0.19
<b>CAGR</b>	3.97%	10.09%	5.22%	0.32%	-0.76%

*Source:* Indian Port Association – Annual Reports compiled (2004 to 2019)

### **Total Traffic Handled by Major Ports**

The table 2 shows the traffic handled by Indian major ports. The Port of Kandla has the highest mean score of 84583.35 tons followed by JNPT 63491.19 tons Vizag 63433.95tons while the Port of Kolkata registered a low mean score with 32814.13 tons. Consistent performance was reported by new Mangalore port. Kamarajar port and Kandla port registered positive growth rate of 17.70 per cent and 15.93 per cent respectively.

### **Total Vessel Traffic**

The total vessels handled by the ships are analyzed in detail. JNPT handled more vessels with vessels. Kamarajar port witnessed less vessels calling on port with 260 vessels. The CAGR of Cochin port was 3.84 per cent. Two major ports, namely, port of Haldia and VOC registered negative CAGR of -1.94 and -2.13 respectively. Tasks are ordered by appearance and takeoff and incorporate an exceptional identifier for every vessel and timestamp showing the date and hour of appearance or flight taking into consideration the computation of time in port.

**Table 2: Descriptive Statistics for Total Traffic Handled by Major Ports (in tonnes)**

<b>Year /Ports</b>	<b>Calcutta</b>	<b>Hal dia</b>	<b>Par adip</b>	<b>Viz ag</b>	<b>Ch ennai</b>	<b>VO C</b>	<b>Kam arajar</b>	<b>Coc hin</b>	<b>Man galore</b>	<b>Mor mug oa</b>	<b>Mu mb ai</b>	<b>JN PT</b>	<b>Kan dla</b>
2004-05	9945	36262	30104	50147	43806	15811	9480	14095	33891	30659	35187	32808	41551
2005-06	10806	42216	33109	55801	47248	17139	9168	13938	34451	31688	44190	37746	45907
2006-07	12596	42454	38517	56385	53414	18001	10714	15257	32042	34241	52364	44815	52982
2007-08	13741	43541	42438	64597	57154	21480	11563	15810	36019	35128	57039	55756	64893
2008-09	12280	48000	46412	63908	57491	22011	11500	15228	36691	41681	51876	57281	72225
2009-10	13045	33378	57011	65501	61057	23787	10703	17429	35528	48847	54541	60763	79500
2010-11	12540	35005	56030	68041	61460	25727	11009	17873	31550	50022	54586	64309	81880
2011-12	12233	31012	54254	67420	55707	28105	14956	20091	32941	39001	56186	65727	82501
2012-13	11844	28084	56552	59040	53404	28260	17885	19845	37036	17693	58038	64490	93619
2013-14	12874	28511	68003	58503	51105	28642	27337	20887	39365	11739	59184	62333	87004
2014-15	13156	27976	69418	66434	58742	31508	21448	21547	36861	27650	63230	74157	101836
2015-16	13332	26363	73268	67433	59571	33074	22905	22365	37208	26483	65214	77713	107587
2016-17	13507	24750	77118	68433	60400	34640	24363	23183	37555	25315	67198	81268	113338
2017-18	13683	23137	80968	69433	61228	36206	25820	24002	37902	24148	69181	84823	119089
2018-19	13859	21524	84818	70433	62057	37772	27277	24820	38250	22981	71165	88379	124839
$\bar{x}$	12629.40	32814.13	57868.03	63433.95	56256.30	26810.89	17075.18	19091.32	35819.37	31151.76	57278.57	63491.19	84583.35
$\bar{x}.De v.$	821.57	6820.94	14184.70	4972.50	4380.50	5829.36	6334.46	3201.23	1935.10	8339.42	6967.94	12391.51	20697.04
<b>MA X</b>	13858.60	4800.00	84818.12	70432.98	62057.05	37771.75	27337.00	24820.16	39365.00	50022.00	71165.08	88378.70	124839.38

<b>P50</b>	128 74. 00	310 12. 00	565 52. 00	655 01. 00	574 91. 00	281 05. 00	1495 6.00	198 45. 00	3669 1.00	3065 9.00	570 39. 00	643 09. 00	825 01.0 0
<b>MIN</b>	994 5.0 0	215 24. 07	301 04. 00	501 47. 00	438 06. 00	158 11. 00	9168 .00	139 38. 00	3155 0.00	1173 9.00	351 87. 00	328 08. 00	415 51.0 0
<b>σ</b>	106 6.6 8	791 3.3 8	168 33. 13	580 8.2 7	531 8.9 8	679 2.4 5	6815 .51	357 1.8 8	2274 .22	1035 8.56	918 0.3 1	158 60. 64	251 34.9 5
<b>CV</b>	0.0 8	0.2 4	0.2 9	0.0 9	0.0 9	0.2 5	0.40	0.1 9	0.06	0.33	0.1 6	0.2 5	0.30
<b>CA GR</b>	2.2 4%	- 3.4 2%	7.1 5%	2.2 9%	2.3 5%	5.9 8%	7.30 %	3.8 4%	0.81 %	- 1.90 %	4.8 1%	6.8 3%	7.61 %

*Source:* Indian Port Association – Annual Reports compiled (2004 to 2019)

**Table 3: Descriptive Statistics for Vessel Traffic Handled by Major Ports (In NOS)**

<b>Ports /Year</b>	<b>Cal cutt a</b>	<b>Hal dia</b>	<b>Par adi p</b>	<b>Viz ag</b>	<b>Che nna i</b>	<b>VO C</b>	<b>Kam araja r</b>	<b>Co chi n</b>	<b>New Man galor e</b>	<b>Mor mug oa</b>	<b>Mu mb ai</b>	<b>Jn pt</b>	<b>Ka ndl a</b>
2004 -05	765	188 9	104 1	170 4	165 6	151 7	166	113 3	879	677	180 0	212 6	182 3
2005 -06	767	208 6	120 9	184 3	166 9	147 9	171	112 0	1067	664	188 3	232 4	194 0
2006 -07	767	208 6	133 0	210 9	185 7	157 6	173	122 5	1087	642	215 3	239 5	219 4
2007 -08	904	188 9	145 2	209 9	205 9	153 3	201	117 6	1039	699	223 6	277 5	212 4
2008 -09	101 2	237 3	151 3	234 6	205 2	160 2	213	806	1144	443	170 9	310 6	259 8
2009 -10	105 7	239 8	153 6	234 7	207 8	152 4	250	757	1184	435	161 2	309 6	277 6
2010 -11	129 9	216 3	153 1	240 6	213 1	141 4	273	872	1186	465	163 9	297 3	251 7
2011 -12	132 7	218 9	150 6	250 7	218 1	140 2	294	125 5	1121	948	215 6	310 0	269 2
2012 -13	122 2	196 2	134 2	247 0	204 3	149 2	385	138 2	1155	785	205 7	291 6	271 4
2013 -14	123 4	192 1	127 9	206 6	192 8	129 2	475	136 7	1096	473	194 9	258 8	273 4
2014 -15	135 5	181 3	127 3	226 4	200 1	128 9	504	164 6	1086	740	221 0	261 3	272 1

2015 -16	140 2	171 2	122 3	223 7	198 2	124 1	560	181 9	1066	780	231 9	250 5	273 2
2016 -17	144 8	161 1	117 2	221 1	196 3	119 4	616	199 2	1045	819	242 9	239 8	274 3
2017 -18	149 5	151 0	112 1	218 4	194 3	114 6	673	216 5	1024	859	253 8	229 1	275 4
2018 -19	154 2	140 9	107 0	215 8	192 4	109 9	729	233 8	1004	898	264 7	218 4	276 6
$\bar{x}$	117 3.08	193 4.0 9	130 6.5 7	219 6.7 5	196 4.52	138 6.6 6	378.8 7	140 3.4 0	1078. 83	688.4 7	208 9.13	262 5.9 7	252 1.8 3
$\bar{x}$ .De v.	235. 53	229 .12	141 .86	161 .90	108. 16	141 .20	171.9 9	392 .13	57.15	136.0 4	263. 32	294 .69	268 .16
<b>MA X</b>	154 1.76	239 8.0 0	153 6.0 0	250 7.0 0	218 1.00	160 2.0 0	728.8 0	233 7.6 0	1186. 00	948.0 0	264 7.00	310 6.0 0	277 6.0 0
<b>P50</b>	123 4.00	192 1.0 0	127 9.0 0	221 0.8 6	198 2.05	141 4.0 0	294.0 0	125 5.0 0	1086. 30	699.0 0	215 3.00	258 8.0 0	271 4.0 0
<b>MIN</b>	765. 00	140 8.6 7	104 1.0 0	170 4.0 0	165 6.00	109 9.0 5	166.0 0	757 .00	879.0 0	435.0 0	161 2.00	212 6.0 0	182 3.0 0
$\sigma$	265. 17	282 .91	164 .43	211 .33	143. 61	158 .64	191.1 4	472 .37	75.91	163.6 4	310. 60	334 .02	318 .33
<b>CV</b>	0.23	0.1 5	0.1 3	0.1 0	0.07	0.1 1	0.50	0.3 4	0.07	0.24	0.15	0.1 3	0.1 3
<b>CAG R</b>	4.78 %	- 1.9 4%	0.1 9%	1.5 9%	1.01 %	- 2.1 3%	10.37 %	4.9 5%	0.89 %	1.90 %	2.60 %	0.1 8%	2.8 2%

*Source:* Indian Port Association – Annual Reports compiled (2004 to 2019)

**Table 4: Descriptive Statistics for Total Container Throughput of Major Ports in India  
(In 000 TEU'S)**

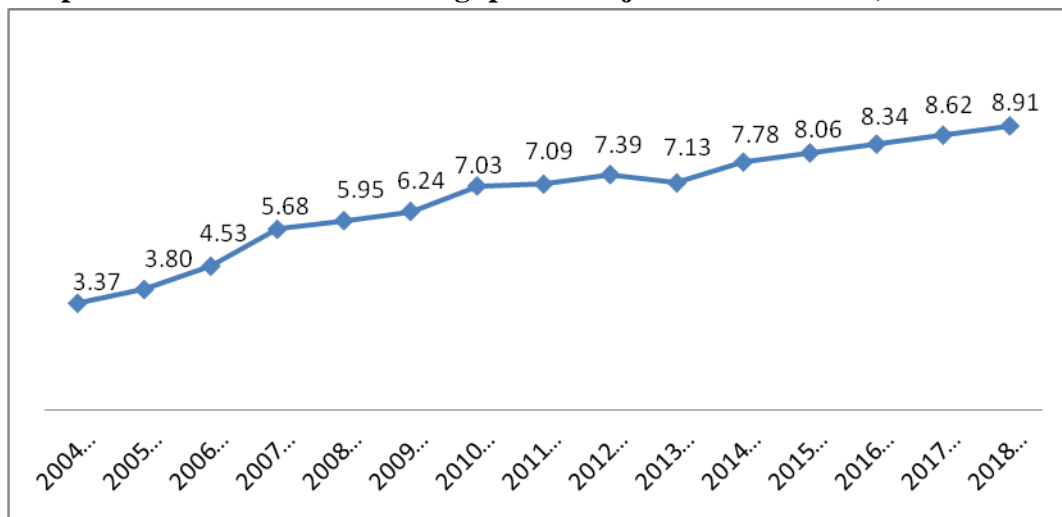
Ports/ Year	Calcutta	Haldia	Paradi p	Vizag	Cheennai	VO C	Cochin	New Mangalore	Mormugoa	Mumbai	JNP T	Kandla	Total
2004-05	2357	2029	31	635	9864	3205	2315	136	117	2571	28747	2754	54761
2005-06	3234	1711	45	630	11756	3428	2539	149	105	1957	33777	2311	61642
2006-07	4003	1918	31	799	14166	4011	2949	265	127	1580	40810	2778	73437
2007-08	5139	2242	54	1133	18049	5630	3239	319	135	1632	51923	2639	92134
2008-09	5483	5483	31	1362	20581	5482	3521	404	147	1291	50602	2143	96530
2009-10	6646	2010	44	1678	23477	6599	3928	475	192	606	53095	2436	101186
2010-11	6220	2835	61	2572	29422	8169	4299	568	182	653	56426	2586	113993
2011-12	6818	2619	109	4214	30076	9227	4583	645	231	551	53095	2791	114959
2012-13	6960	2869	171	4554	29708	9372	4607	692	213	829	57911	1935	119821
2013-14	7062	3174	99	4916	28330	10129	4785	747	235	450	55234	452	115613
2014-15	7475	3410	145	6124	32742	11178	5047	826	246	577	56881	1511	126162
2015-16	7745	3646	161	6970	34401	12004	5249	893	257	563	57457	1370	130716
2016-17	801	388	177	781	360	128	545	959	269	550	580	123	135



6-17	4	2		6	61	31	1				34	0	274
2017-18	8284	4118	192	8662	37721	13657	5654	1026	281	536	58610	1090	831
2018-19	8553	4354	208	9507	39381	14483	5856	1093	293	523	59186	950	144387
$\bar{x}$	6266.18	3086.57	103.91	4104.80	26382.29	8627.03	4268.13	613.13	201.97	991.27	51452.57	1931.73	
$\bar{x}.D$ ev.	1488.14	861.27	58.04	2656.61	8053.43	3182.03	949.04	263.46	54.50	543.29	6916.57	664.99	
<b>M</b> <b>AX</b>	8553.29	5483.00	207.76	9507.40	39380.62	14483.30	5855.80	1093.00	292.50	2571.00	59186.30	2791.00	
<b>%</b> <b>P50</b>	6818.00	2869.00	99.00	4214.00	29422.00	9227.00	4583.00	645.00	213.00	606.00	55234.00	2143.00	
<b>MI</b> <b>N</b>	2357.00	1711.00	31.00	630.00	9864.00	3205.00	2315.00	136.00	105.00	450.00	28747.00	452.00	
$\sigma$	1808.33	1034.33	63.61	3016.83	9242.08	3644.95	1100.58	303.86	61.21	633.90	9122.12	746.06	
<b>CV</b>	0.29	0.34	0.61	0.73	0.35	0.42	0.26	0.50	0.30	0.64	0.18	0.39	
<b>CA</b> <b>GR</b>	8.97%	5.22%	13.52%	19.77%	9.67%	10.58%	6.38%	14.90%	6.30%	-10.08%	4.93%	-6.85%	

**Source:** Indian Port Association – Annual Reports compiled (2004 to 2019)

**Note:** TEU-Twenty-foot Equivalent Units

**Graph 2: Total Container Throughput of Major Ports in India (In % Growth)**

### Total Container Throughput

Table 4 portrays the holder throughput of significant ports for the review time frame. The CAGR of the port of Vizag was 19.77 percent. Mumbai port and Kandla port have shown the negative growth rate 10.08 and 6.85 percent respectively. Jawaharlal Nehru Port Trust has more container throughput with 59186 TEU's out of 12 major ports in India. The CAGR of JNPT was 13.59 per cent with a low Co-effective of Variance of 64%. This shows the strength of this port in container throughput. It is emerging as a compartment dealing with port confidence in Eastern Ocean side lines of India near Vizag.

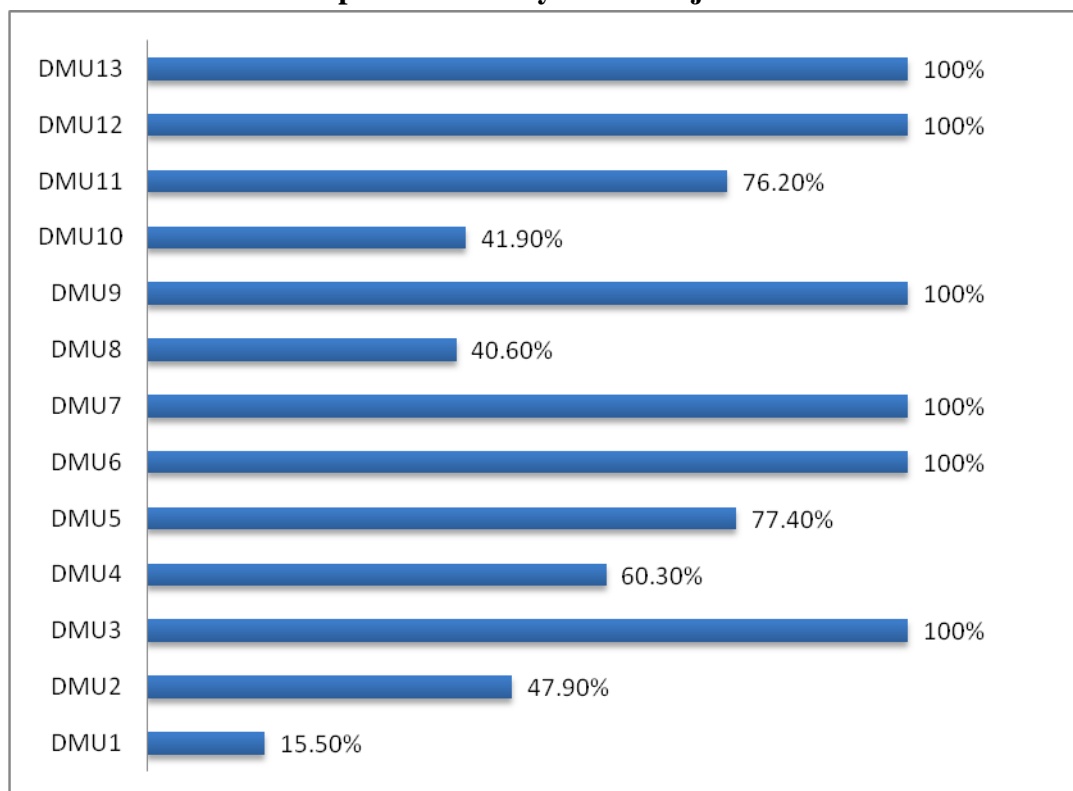
### DATA ENVELOPMENT ANALYSIS (DEA) –Basic Radial Model – Efficiency Measurement

In a cutthroat world by far most of the ports need to analyse productivity. Considering the above need the current examination used yield arranged DEA model. It is used for estimating the efficiency of all major ports in India. This method is applied for measuring the adequacy of ports. Table 5 indicates about the data yield factors. The efficiency scores of different major ports were given in the graph 1. Some ports, namely, Vizag, kamarajar, JNPT and Kandla have shown remarkable facilities in terms of Berth, Storage, Equipments and Traffic. The efficiency of Kolkata port is the least with 16 per cent facilities with report to the facilities available. The efficiency of the port they don't use the resources effectively. The compartment throughput and complete traffic were considered as the yield factors in the current review for assessing the port proficiency. The port of Cochin did not perform well as expected during the study period. In view of the DEA CCR results the ports like Mormugao, Tuticorin, Ennore and JNPT together involved top position. Followed by Paradip port positioned fifth position and Chennai port positioned 6th position.

**Table 5: Input- Output Variables of the Major Ports in India**

Posts/I & O	Berth (I) (Nos)	Storage (I) (In Sq Mts)	Equipment (I) (Nos)	Traffic (O) (In Tons)	Efficiency %
Kolkata (DMU 1)	33	328981	93	12874	16
Haldia (DMU 2)	19	921840	39	28511	48
Paradip (DMU3)	18	2207476	14	68003	100
Vizag (DMU4)	23	3499988	44	58503	60
Chennai (DMU5)	24	596473	189	51105	77
Vizag (DMU6)	6	899645	20	28642	100
Kamarajar (DMU7)	15	1180964	0	27337	100
Cochin (DMU8)	20	273487	67	20887	41
New Mangalore (DMU 9)	16	109124	6	39365	100
Mormagoa (DMU10)	9	424380	11	11739	42
Mumbai (DMU11)	31	296290	65	59184	76
JNPT (DMU12)	12	4786562	513	62333	100
Kandla (DMU13)	27	1517824	31	87004	100

**Source:** Indian Port Association – Annual Reports compiled (2004 to 2019)

**Graph 2: Efficiency of the Major Ports**

**Source:** Indian Port Association – Annual Reports compiled (2004 to 2019)

Port of Kolkata enlists an exceptionally low effectiveness score of 16%. However CAGR for the absolute weight of traffic dealt with by the port is positive. The general traffic

execution of this port is showing a positive pattern however the productivity is least. This uncovers that the presentation productivity of the ports may not reflect in their operational yield. Ports of Haldia, Cochin and Mormagoa have 48, 41 and 42 percent individually, which are under 50% yet their weight took care of are positive enough in their growth.

Ports of Chennai and Mumbai have 77 and 76 percent productivity separately Chennai port has 23.4 percent growth while the Mumbai port shows - 29.43 percent in holder traffic. The traffic handled by these ports are positive however at a diminishing rate of 3.13 and 10.96 percent for Chennai and Mumbai individually. The traffic handled of is developing however at a low rate of 3.08 and 1.60 percent respectively.

### **Findings**

- ❖ The significant ports handle the greater part of the traffic when compared differently in relation to non-significant ports yet the rate piece of the significant ports is fundamentally declining from 2008-09. Regardless, the non-significant ports are dealing with more traffic a serious long time after year and came to 22.81 percent during 2018-19.
- ❖ The traffic handled shows the efficiency of major ports. Kandla port has the mean score of 845483.35 tonnes. This indicates more traffic handled by kandla port. Port of Kolkata handled 32814.13 tons.
- ❖ The efficiency of Kamarajar port trust comes to 23.59 per cent of CAGR. It is followed by port of Paradip 17.7. per cent and port of Kandla 15.93. the negative growth was registered with port of Haldia and Mormagoa with -4.70 per cent and -17.47 per cent respectively.
- ❖ The Cochin Port has a CAGR of 3.84 percent showing high CV of 34%. Further the Port of Haldia and VOC have registered a negative development pace of 1.94 and 2.13 separately.
- ❖ The CAGR of the port of Vizag exhibits more growth with 19.77 percent. The Ports of Mumbai and Kandla have experienced a negative growth of 10.08 and 6.85 percent respectively. JNPT has more capacity for dealing the loading and unloading of activities. It has the mean score of 51452 TEUs and 59186 TEUs throughout. This is the largest one among the Indian ports.

### **Suggestions**

- ❖ The capacity of the ports may be increased with the introduction of new state of art infrastructure in major ports.
- ❖ Steps have to be augmented to raise the quality of major ports on par with established standards.
- ❖ India is blessed with more coastal lines and this may be used for enhancing the international trade and reaping the fore benefits out of it. More handling of traffic may be considered and new routes of trade have to be established for easy access to the international market.
- ❖ The socio-economic and geological aspects may be considered for developing ports in India.

### **Conclusion**

The study has assessed the efficiency major ports. It highlighted the port about port not reflecting the functional aspects. Inefficient ports have led to the adding up of load up requirements depending on the adequacy by ideal usage of resources, limit development plans, fitting port improvement draws near and effective time. The turnaround time may be

reduced and the investment in port infrastructure must be taken into consideration. This would enhance operational efficiency of the ports. Indian coastal lines may be skillfully utilized for constructing new ports and the expansion of the existing major ports.

### References

1. Quintano, Claudio, Paolo Mazzocchi, and Antonella Rocca. "A competitive analysis of EU ports by fixing spatial and economic dimensions." *Journal of Shipping and Trade* 5.1 (2020): 1-19.
2. Abdoukarim, Hamadou Tahirou, Seydou Harouna Fatouma, and Elijah Musango Munyao. "Dry Ports in China and West Africa: A Comparative Study." *American Journal of Industrial and Business Management* 9.03 (2019): 448.
3. George Kobina, Van Dyck. Assessment of Port Efficiency in West Africa using Data Envelopment Analysis. *American Journal of Industrial and Business Management*. 2015; 5:208-218.
4. Ziaul Haque Munim, Mohammad Hassan Shakil, Mashiyat Tasnia, Md. Kazi Golam Azam. Operational and Financial Performance Analysis of Chittagong Port Authority in Comparison with the Maritime and Port Authority of Singapore. *European Journal of Business and Management*. 2014, 6(38).
5. Pjevcevic D, Radonjic A, Hrle Z, Colic V. DEA analysis for measuring port efficiencies in serbia. *Promet- Traffic & Transportation*, 2012; 24(1):63-72.
6. Ahmed Salem Al-Eraqi, Carlos Pestana Barros, Adli Mustafa, Ahmad Tajudin Khader. Evaluating the Location Efficiency of Arabian and African Seaports Using Data Envelopment Analysis (DEA), 2007. WP 09/DE/UECE
7. Khalid, Bichou. Review of port performance approaches and supply chain framework to port performance benchmarking. *Research in Transportation Economics*. 2006; 17:567-59.
8. Chandrasekaran N, Mohankumar S. a White paper on seaports: challenges and issues in India, Confederation of Indian industry, 2005.
9. Patrick, Fourgeau. Measuring port performance, The World Bank report, 2000.
10. Sehgal.P, Kumar.B, Sharma.M, Salameh A.A, Kumar.S, Asha.P (2022), Role of IoT In Transformation Of Marketing: A Quantitative Study Of Opportunities and Challenges, *Webology*, Vol. 18, no.3, pp 1-11
11. Kumar, S. (2022). A quest for sustainium (sustainability Premium): review of sustainable bonds. *Academy of Accounting and Financial Studies Journal*, Vol. 26, no.2, pp. 1-18
12. Marlow P, Paixao A. Measuring Lean Ports Performance. *Proceedings of the International Association of Maritime Economists*, Panama, 2002, 13-15.
13. Martinez-Budria E, Diaz-Armas R, Navarro-Ibanez M, Ravelo-Mesa T. A Study of the Efficiency of Spanish Port Authorities Using Data Envelopment Analysis. *International Journal of Transport Economics*. 1999; 26:237-253.
14. Terminals Using Data Envelopment Analysis. *International Journal of Integrated Supply Management*, 1, Jose L.Tongzon Determinants of port performance and efficiency. *Pergamon*, 1994; 29-A (3):245-252.
15. Talley, Wayne K. Performance indicators and port performance evaluation, *Logistics and Transportation Review*. 1994; 30(4):339-345.