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Constructing the Road to Future: Challenges and Implications for Indian Cement Industry

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Abstract

The paper discusses the growth and financial sustainability of cement industry in India. It has been found that China is the largest cement producer in the world followed by India. India has a significant share in global cement market. UltraTech Cement has the highest market capitalization in India, followed by Shree cement, Dalmia bharat, Ramco cement, and India cement. Quantity of cement export from India is higher than its import quantity. Production and consumption of cement are increasing continuously. Environmental issues, land acquisition, and logistics are the major challenges before the cement industry.

India is the second-largest cement producer in the world and accounts for over 8% of the global installed capacity. Of the total capacity, 98% lies with the private sector and the rest with the public sector. The top 20 companies account for around 70% of the total cement production in India. As India has a high quantity and quality of limestone deposits throughout the country, the cement industry promises huge potential for growth. In 2023, the market size of India's cement industry reached 3.96 billion tonnes and is expected to touch 5.99 billion tonnes by 2032, exhibiting a CAGR of 4.7% during 2024-32. India's cement production reached 374.55 million tonnes in FY23, a growth rate of 6.83% year-on-year (YoY). The Government of India is strongly focused on infrastructure development to boost economic growth and is aiming for 100 smart cities. The Government also intends to expand the capacity of railways and the facilities for handling and storage to ease the transportation of cement and reduce transportation costs. These measures would lead to increased construction activity, thereby boosting cement demand.

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1. Introduction

Cement is a rich powder, usually grey in colour which is indispensable in current society. The most essential materials for cement production are limestone, clay, and marl. Cement, combined with water, acts as a binder to bind sand, gravel, and hard rock into concrete. Portland cement is the most common form of cement used internationally. It was introduced in early 19th century by Joseph Aspdin. Portland cement is economical because limestone, shale and other materials are comparatively cheap and amply available. Portland cement became the first which was broadly used in England and France between 1850 and 1880 by Francois Coignet, who added metal rods for construction of walls.

The first cement manufacturing facility became mounted in Porbandar, Gujarat in 1904, but its manufacturing began with a manufacturing unit installed in Madras by using an agency called South India Industries limited. This industry is growing worldwide rapidly due to urbanization. The manufacturing technique of Portland MAAs is split into four steps: (a) grinding the burning fabric with gypsum, (b) burning the prepared mixture inside the kiln, (c) mixing the materials in exact proportions, and (d) crushing and digesting the raw substances. The working life of a cement kiln is for around 30-50 years. Therefore, new kilns are constructed only in places wherein massive organisations can be developed. Cement plants are generally built close to the source of raw materials, which will reduce the transportation costs and saves time.

Literature Review

Gupta and Patel (1976)^[3] concluded that in 1947 Madras and Bihar were the main states in cement production, but in 1971 the main states had been Madras, Madhya Pradesh, Gujarat and so on. The adjustments are visible to be prompted by the economic

cement system as well. The government can boost up this technique by using appropriate licensing and tax incentives. Tyagi (2012) ^[16] examined the results of return on working capital, return on equity, freezing sales, and dividend and fixed assets of companies. Kumar *et al.* (2013) ^[4] observed that the Indian cement industry has bright future potentiality in manufacturing, output and revenue. Kumar *et al.* (2013) ^[4] conducted a detailed and qualitative study on Indian cement enterprise in terms of unit ability, manufacturing, and exports. Gupta and Patel (1976) ^[3] concluded that Tamilnadu and Bihar were the leading states in cement production after independence while in 1971 the leading states were Tamilnadu, Madhya Pradesh, Gujarat, etc. The changes are seen to be influenced by the economy as well. The government can accelerate this process by using appropriate licensing and tax incentives.

Kumar *et al.* (2013) ^[4] in their report found that the Indian cement sector has not shown good development in terms of capacity, production, output and revenue. Its future is bright. However, further expansion, planning and effective management should focus on expansion and value addition. Kumar *et al.* (2013) ^[4] conducted a detailed and qualitative study on the development of Indian cement industry in terms of unit capacity, production, exports and value added activities growing since 1991. Sasikala and Balakrishnan (2015) ^[14] studied the demanding situations and prospects faced by way of Indian cement companies. This research helps in investment decisions and predicting future activities. It also useful for figuring out strengths and weaknesses and taking suitable selections to gain their outcomes. Pandey (2017) ^[9] concluded that cement is vital for financial improvement. The sector can grow and high-quality limestone is found in almost all part of India; Mekha and Reddy (2018) ^[7] in their document concluded that cement plays a critical function in the Indian financial system. that is due to the fact it is related to sectors which includes production, transportation, trade, actual estate, mining and electricity. The industry also related to raw substances, skilled workers, job information and job protection for lots merchandise.

Yadav (2018) ^[17] concluded that although the cement industry has been in existence since 1914, cement production did not progress until partial liberalization in 1982 and finally full liberalization in 1989 and the de-licensing in 1991. Sharma and Khurana (2020) ^[15] examined development of market concentration and competition in the Indian cement industry over 20 years. The paper finds evidence of economic strength in the Indian cement industry. Abbasbhai (2019) ^[1] found that the Indian cement industry is a significant part of its economy and generates revenue for the government. The implementation of GST will affect the share prices of cement companies. It is very important to understand the changes in share prices in the cement sector. Reddy (2020) ^[13] has tried to conduct a retrospective analysis of the Indian cement industry. It examined the current status of the cement industry from the perspective of resource utilization and provide suggestions for resource utilization. The cement industry has an important position in the world and is a vital product of the construction sector and contributes to the country's economy. It is a capital-intensive, energy-intensive, and investment-intensive industry.

Ravi and Shambhulingappa (2022) ^[11] in their report examined the historical development of the cement industry in India. Cement is one of the most important elements in building a strong and healthy infrastructure. It plays a significant role in the economic development of any country. With a history of over one hundred and fifty years, it is widely

used in the construction of many buildings, from small houses to large multipurpose projects. Kumar and Sinha (2022) ^[4] pointed out that the position of the Indian cement industry in the world rankings is better than many developed countries, but there is still room to achieve the significance of being the world's largest cement producer. The initiatives and statements of the government, and the subsequent activities of relevant organizations, including the private sector, will help India become to achieve five trillion economy in near future and the cement sector will play a vital part in this regards. Acharya and Dave (2022) ^[2] discussed the Goods and Services Tax on cement industry. This study examines the needs before the establishment of the tax system and the impact and effects of the tax system on the cement sector and its economic impact afterwards.

Ray *et al.* (2023) ^[12] concluded that the Adani group is facing complaint and controversies regarding its cement business, especially regarding environmental and social components. Critics have raised issues approximately the environmental impact of Adani institution's cement plant, which includes air and water pollution. There also are worries about changes in local communities and their effect on their lifestyles. Mudgal and Chellasamy (2024) ^[8] offer a detailed analysis of the boom of the Indian cement industry, the environmental effect of cement manufacturing, and its tremendous implications for the future of the Indian stone enterprise. The cement industry in India forms a good sized part of economy and creating job opportunities for millions of youths.

Therefore, from the above analysis it has been concluded that majority of the study discussed the growth and prospects of cement industry in India. Very few studies have discussed the export-import and financial feasibility of the cement industry. Therefore, this study chooses the present topic.

Objectives of the Study

The general objective of the paper is to study the growth and financial sustainability of cement industry in India. The specific objectives of the paper are:

- To study the global trend of production of cement and leading producing countries,
- To analyse the capacity utilisation by cement industry in India,
- To study the challenges before cement industry in India and policies of government for mitigating such challenges.

Hypotheses of the Study

The following are the hypotheses of the present study:

- H_{01} : There is no relationship between production of cement and export of cement in India.
- H_{1a} : There is relationship between production of cement and export of cement in India.
- H_{02} : There is no relationship between production of cement and import of cement in India.
- H_{1b} : There is relationship between production of cement and import of cement in India.

Methods and Materials

This study is descriptive in design and has utilised qualitative and quantitative approaches. The secondary data for the study have been collected from the website of the Cement Corporation of India Limited, Government of India, and various research papers. To reveal the trade of cement production in India in general and export/import perspectives in particular, descriptive analysis, content text analysis, and regression analysis have been performed. There are three variables in simple regression study between production, and

export and import of cement in India. Production of cement is the dependent variable. Export and import of cement are the independent variables. The Regression analysis is calculated on information of production, export and import of cement in India during 2012-13 to 2020-21.

Results and Discussion

China is the largest cement producer followed by India. India has significant share in global cement market. The first cement industry was established in Chennai, Tamilnadu in 1904. The plant was established by South India Industries Ltd. There are many private players in India's cement industry. Ultratech Cement is the largest manufacturer in India. It is one of the international's most prestigious organizations internationally this industry has attracted huge local and foreign investments.

Table 1: Global Production Volume of Cement

Year	Quantity	Year	Quantity	Year	Quantity
1995	1.39	2013	4.08	2019	4.10
2000	1.60	2014	4.18	2020	4.20
2005	2.30	2015	4.10	2021	4.40
2010	3.31	2016	4.20	2022	4.10
2011	3.60	2017	4.05	2023	4.10
2012	3.70	2018	4.10		

Source: <https://www.statista.com/statistics/1087115/global-cement-production-volume/>, Note: Figures in billion metric tons.

Table 1 discusses the world-wide production of cement. It has been found that the global production of cement is increasing continuously, which was slightly declined after 2021. It has increased more than three times in the last 25 years. The total production of cement was 1.39 billion metric tons in 1995, and 4.40 billion metric tons in 2021. It declined to 4.10 billion metric tons in 2023. China is the world's largest cement producer, accounting for more than half of the world's supply. From 2002 to 2014, China's cement production grew rapidly to meet the country's development needs. However, since then, the government has announced plans to reduce production to deal with excess capacity in the industry. The cement sector is also facing challenges due to the collapse of the real estate sector. China's cement production capacity in

2022 includes about 1.51 billion tons from integrated cement and about 124.5 million tons per year from grinding plants. The economic development in China has boosted its economic growth and lifted hundreds of millions of people out of poverty.

Table 2: Production Capacity of Cement Worldwide in 2022, by Leading Country

Country	Integrated Total	Grinding Totals	Country	Integrated Total	Grinding Totals
China	1512.2	124.5	Turkey	100.2	8.7
India	336.5	113.6	Indonesia	96.3	6.3
Vietnam	139.8	12.1	Brazil	82.0	18.5
USA	119.0	6.2	Iran	84.9	2.1
Russia	114.0	3.2	Egypt	75.5	-

Source: <https://www.statista.com/statistics/1256776/production-capacity-of-cement-worldwide-by-country/>, Note: Figure in in million metric tons per year

Table 2 discusses the production capacity of cement worldwide in selected countries. It has been found that China has the highest production capacity of cement followed by India, Vietnam, and the USA. India is the world's second largest cement producer. Since deregulation in 1982, the Indian cement industry has attracted large investments from Indian and foreign businesses. UltraTech Cement Ltd. is India's largest producer of grey cement, ready-mix concrete and white cement. It is also one of the world's leading cement producers. Ultratech is the largest among the five cement companies in India. Ultra tech is a subsidiary of Grasim Industries, a part of the Aditya Birla Group. It operates in India, UAE, Bahrain, Bangladesh and Sri Lanka. UltraTech Cement is also the largest cement supplier in India and caters to the needs of neighbouring countries in the Indian Ocean and the Middle East. In the white cement segment, UltraTech has entered the market with the Birla White brand. Ambuja Cement is India's 2nd largest cement producer. ACC is a reputed cement company having 17 plants and seventy-five ready-mix concrete plants. ACC had established its first plant in 1936. Shree Cement Ltd is the another leading company in India. It was founded in 1979 by Bangur family of Kolkata. The organization's present overall cement manufacturing is 29.3 million tonnes.

Table 3: Capacity Utilisation by Cement Industry in India

Year	Production (Million tonnes)	Cement: Outstanding Capacity	Cement: Capacity Addition	Cement: Capacity Utilisation (%)
2015-16	273.9	495.32	15.54	62.1
2016-17	270.4	523.41	28.09	58.4
2017-18	288.0	544.83	21.42	60.0
2018-19	327.7	495.32	15.54	66.2
2019-20	327.3	523.41	28.09	62.5
2020-21	284.9	544.83	21.42	52.3
2021-22	350.6	576.45	31.62	60.8

Source: CMIE, Informatics Economic Research., Note: production figure in Million tonnes.

Table 3 depicts the capacity utilisation of cement industry in India. It has been found that production of cement in India is increasing. The total production of cement was 273.9 million tons in 2015-16 and 350.6 million tons in 2021-22. The undeveloped resources and new resources have also increased over time and the utilization ability of the cement sector has almost stagnated. Dalmia Bharat Ltd is ranked fifth among the top 10 cement companies in terms of total revenue. The company has cement manufacturing facilities in the southern states of Tamil Nadu (Dalmiyapuram and Ariyalur) and Andhra Pradesh (Kadapa) with an annual capacity of nine million tonnes. India Cements Limited was founded in 1946 by two men, Shri S. N. Sankaralinga Iyer and Sri T S

Narayanaswami. Their vision was to support the dreams of Indian business, to turn those dreams into reality, and their ability to build relationships in the future.

India Cement, currently, has eight cement plants in Tamil Nadu, Telangana, Andhra Pradesh and Rajasthan, along with two grinding plants, one each in Tamil Nadu and Maharashtra. It is one of the top cement companies in India. Ramco Cement Limited is the flagship company of the Ramco Group. It is one of the leading companies in South India. Its headquarter is located in Chennai. It is ranked eighth among the top ten cement companies in India. It is the most popular type of cement in South India. Eastern Cement is a Telangana based company. Heidelberg Cement India Ltd.

is a leading company and operates in Damoh (Madhya Pradesh), Jhansi (Uttar Pradesh) in central India and

Amasandra (Karnataka) in southern India.

Table 4: Production and Consumption of Cement in India ('000 million tonnes)

Year	Production	Consumption	Year	Production	Consumption
2011-12	223,500.00	222,378.70	2012-13	240,614.00	240,387.60
2013-14	249,826.00	247,480.30	2014-15	261,338.00	257,412.60
2015-16	273,857.00	271,243.50	2016-17	270,375.00	266,823.50
2017-18	287,964.00	284,721.20	2018-19	327,722.00	324,927.90
2019-20	327,266.00	327,928.90	2020-21	284,913.00	285,308.90
2021-22	350,595.00	351,071.90	2022-23	374,558.50	375,190.70

Source: CMIE, Informatics Economic Research.

Table 4 discusses the production and consumption of cement in India. It has been found that production and consumption of cement are increasing continuously. Production and consumption quantities of cement are nearly the same. Production of cement was 223.5 million tons' in 2011-12, 270.3 million tons' in 2016-17 and 284.9 million tonnes in 2020-21. Consumption of cement was 222.3 million tons' in 2011-12, 266.8 million tons' in 2016-17 and 2.85.3 million tonnes in 2020-21.

Cement is an important material used in the construction of roads, dams, power plants, buildings and factories. It is used as a seal in concrete, which is a simple material for construction. Cement is used to bond building materials such as bricks, tiles and concrete. It can also fill the gap between plaster and wall and seal pipes, cables and wires. It is strong and durable against other materials such as wood and metal. It is used to repair surfaces, floors, stairs, driveways, swimming pools, tables, statues and bookcases. Petroleum cement is used to create or secure petroleum. It is made from iron, coke, limestone and scrap metal. White cement is used in construction applications such as facades, prefabricated panels and decorative elements. It is known for its aesthetic appeal and smooth, elegant surface. Cement is often used as a base material for all types of construction, including buildings, roads, schools, hospitals, dams and docks, as well as decorative materials (yards, floors, stairs, driveways, pools, terraces) for concrete, and also objects such as tables, statues or books.

Table 5: Number of Cement Plants in India by Type (2020-2022)

Characteristic	Integrated totals	Grinding totals	Overall total
2020	158	93	251
2021	159	95	254
2022	161	98	258

Source: <https://www.statista.com/statistics/1351448/india-number-of-cement-plants-by-type/>

Table 5 discusses the pattern of cement plants in India. It has been found that the overall number of cement plants in India has increased. The total number of plants were 251 in 2020 and 254 in 2021 and finally 258 in 2022. The total number of integrated and grinding plants have also increased during the period. Integrated totals are higher than the grinding totals. The number of integrated totals were 158 in 2020 and 159 in 2021 and finally 161 in 2022. Grinding totals were 93 in 2020, 95 in 2021 and 98 in 2022.

There are numerous types of cement in the market. Some of them are ordinary silicate cement, volcanic ash silicate cement, rapid hardening cement, ultra-rapid hardening cement, rapid cement, low heat cement, sulphate resistant cement, blast furnace slag cement, high alumina cement and others. There are also cement plants in various states of India.

Central Public Sector Undertaking has 10 units in eight states and Union Territories. But only three of these plants are still operational, the rest have been closed for over a decade. The state's industrial sector consists of five major cement companies, namely Mawmluh-Cherra Cement Ltd., J&K Ltd., Malabar Cements and Tamil Nadu Cement. Some of the private companies with cement plants in India are Deccan Cement Ltd., Dalmia Cement (Bharat) Ltd. and Chettinad Cement Corporation Private Limited. Deccan Cement Plant is located in the state of Telangana. Dalmiya Cement Plant is located at Kadapa, Dalmiyapuram, Ariyalur, Belgaum, Sattur, Adunike and other places. Chettinad cement plants are located at Kallur, Puliyur, Karikkali and Ariyalur.

Table 6: Distribution of Demand for Cement in India, 2021

Sector/Area	Percentage	Sector/Area	Percentage
Rural Housing	29	Low cost Housing	12
Urban Housing	25	Commercial	11
Infrastructure	23		

Source: <https://www.statista.com/statistics/799896/india-share-of-cement-demand-by-sector/>

Table 6 depicts the demand for cement in various sectors in India. It has been found that there is a demand for cement in construction of housing, infrastructure and commercial uses. The demand is higher in rural construction, followed by urban construction, infrastructure, low-rise housing and workplaces. Cement factories employ workers to perform various tasks in the production of cement and concrete. These processes include finishing, demoulding, fixing rebar and assembling and greasing the moulds. These factories use raw materials such as clay, limestone and sand to produce cement. The production process includes many industrial processes such as emission control, cooling, clinker shaping, kiln-firing, preheating, crushing, quarrying, grinding, mixing and blending.

India pays 28% plus 12% surcharge on cement items, which is 28 plus 12% of 28 in totalling 31.36%. However, cement used in some buildings is lower than the GST rate. GST rate on cement is one of the highest in India. High GST on cement increases the overall construction costs and is a major concern for manufacturers and developers. It has impacts on the cement sector. The history of low competition and cartelization in the cement sector also makes the government cautious about reducing tariffs. A higher GST on cement increases production costs, which are usually passed on to consumers. This affects affordability, especially affordable housing. GST on cement increases the cost of various materials used in cement production, such as limestone, clinker and transportation. Higher prices of cement and other building materials due to GST could deter buyers from investing in new homes.

Table 7: Share of Global Cement Produced in India (2015-2022)

Year	Share (%)	Year	Share (%)
2016	6.2	2019	7.8
2017	6.8	2020	7.0
2018	8.2	2022	9.5

Source: <https://www.statista.com/statistics/1285635/india-share-of-global-cement-production/>

Table 7 discusses the share of global cement produced in India. It has been found that the share of India in global production of cement is increasing continuously. This share was 6.2 percent and 7.8 percent in 2018 and 9.5 percent in 2022. India is one of the largest cement producers and exporters in the world. It is the second largest cement producer with an annual capacity of 298 million tonnes. In 2022, India's cement exports was worth US\$ 58.8 million. The important destinations of India's cement exports are Sri Lanka, Maldives, Nepal, Bangladesh and Bhutan. The cement exporters in India include J Ambuja Cement, OK Cement, ACC Cement, Ultratech Cement and Dalmia Cement. The Indian cement enterprise is ruled by means of non-metal minerals, the primary raw materials being limestone and coal.

Table 8: Price of Cement in India (2016 -2022)

Year	Price per bag	Year	Price per bag
2015	224	2019	255
2016	231	2020	292
2017	247	2021	298
2018	225	2022	318

Source: <https://www.statista.com/statistics/1301259/india-cement-price/>, Note: Figure in Indian rupees per bag

Table 8 discusses the price of cement in India. It has been found that the price for a bag of cement had increased during 2015-2022. Price per bag cement was Rs.234 in 2015 and Rs. 292 in 2020. Finally, it was Rs.318 in 2022. There are many factors that directly affect cement prices. Some of them are raw material cost, labour cost, transportation cost, economic changes, government policies, productivity, natural disasters, supply and demand, etc. The cement industry is divided into Portland cement, mixed cement and others. Based on the application, the cement industry is segmented into residential and non-residential markets. By region, the cement market is segmented into North America, Europe, Asia Pacific, Latin America, and the Middle East & Africa.

The Indian cement industry is expanding due to the increasing demand for urban housing and government construction projects. India exports most of its cement to Peru, Nepal, and Bangladesh. The major cement exporting countries worldwide are China, Brazil, and Vietnam. China is the world leader in cement exports with 814,202 batches, followed by Brazil with 562,394 batches, while Vietnam ranks third with 455,631 batches. India has become a major player in the global cement industry. India is also considered the world's second largest cement producer. It accounts for more than eight percent of the world's installed capacity. Modernisation and technological advancement have made the Indian cement industry active. India can now compete in the global market as its cement and manufacturing equipment meet international standards and criteria. India does not export much cement due to domestic demand.

Table 9: Leading Cement Companies in India (October 2024) by Market Capitalization

Company	Value	Company	Value
UltraTech Cement	3287.65	Ambuja Cement	1447.94
Shree Cement	893.46	ACC	431.60
Dalmia Bharat	352.39	J.K. Cement	332.46
Ramco Cement	204.78	Nuvoco vistias	125.14
India Cement	112.33	JK Laxmi Cement	95.41

Source: <https://www.statista.com/statistics/1322585/india-leading-cement-companies-by-market-capitalization/>, Note: in billion Indian rupees.

Table 9 depicts the leading cement companies in India by market capitalization. It has been found that UltraTech Cement has the highest market capitalization, followed by Shree cement, Dalmia Bharat, Ramco cement, and India cement. On the other hand, JK Laxmi cement has the least market capitalization preceded by Nuvoco vistias, J.K. cement, ACC, and Ambuja cement. India exports cement to several African countries, including South Africa and Nigeria. Other countries that import cement from India include Bhutan, Oman, United Arab Emirates, Maldives, Madagascar, Djibouti, Qatar, and Nepal.

Table 10: Export Volume of Cement from India in Destinations, 2021

Country	Volume	Country	Volume
Nepal	770.36	Bhutan	25.75
Bangladesh	151.66	Nigeria	4.71
Cote. D'voire	104.53	United Arab Emirates	4.48
Maldives	65.16	Reunion	4.06
Mauritius	30.63	Others	7.62

Source: <https://www.statista.com/statistics/733956/india-export-volume-of-cement-by-destination-country/>, Note: Figures in thousands metric tonnes

Table 10 depicts the export volume of cement from India to other countries. It has been found that Nepal received the highest quantity of cement from India, followed by Bangladesh, Cote. D'voire, Maldives, Mauritius, Bhutan, Nigeria, and United Arab Emirates in 2021. India also imports cement from other countries. India is the world's second largest cement producer, but it still imports cement from other countries. It gets most of its cement from Japan, South Korea, and China. In 2022, Bangladesh exported cement worth \$13.2 million to India, making it a major destination for Bangladeshi cement exports. Bengal cement is popular in the Indian state of Tripura due to its low cost and quality. Some say that cement from neighbouring countries like Bangladesh is being dumped into India, making it difficult for Indian cement to compete. India imported cement worth \$24.4 million from Oman in 2022 and is also a major supplier of cement clinker to India's other countries like Sri Lanka, Malawi, Mozambique and France. In 2023, India imported cement and allied products worth \$8.79 million from Iran, which included Portland cement, high alumina cement, slag cement, persulphate cement and other hydraulic cements. In 2022, India imported cement worth \$15.1 million from Bhutan. Other major exports from Bhutan to India include ferroalloys, dolomite and electricity.

Table 11: Export and Import of Cement in India

Year	Export	Import	Year	Export	Import
2012-13	2136	725	2013-14	2715	698
2014-15	2314	1052	2015-16	3373	1123
2016-17	2677	1709	2017-18	2572	1769
2018-19	2254	1485	2019-20	2040	752
2020-21	1712	780	2021-22	1166	816

Sources: CMIE, Informatics Economic Research, Note: Figures in '000 tonnes.

Table 11 discusses the export and import of cement in India. It has been found that the quantity of cement export from India is higher than its import quantity. Export of cement was 2136 thousand tonnes in 2012-13 and 2677 thousand tonnes in 2016-17. It declined later and reached to 1166 thousand tonnes in 2021-22. On the other hand, import quantity of cement was 725 thousand tonnes in 2012-13 and 1709 thousand tonnes in 2016-17. It declined later and was reached to 816 thousand tonnes in 2021-22.

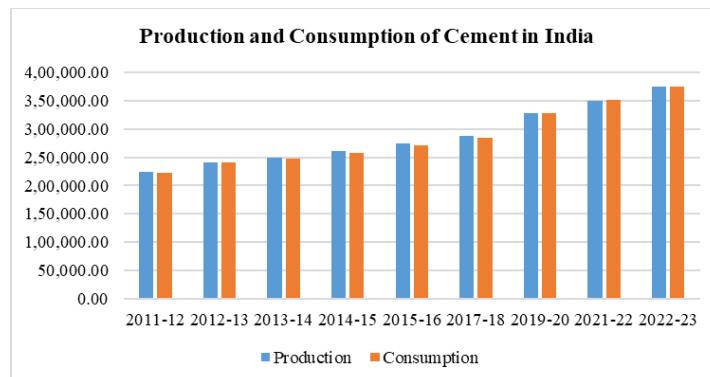
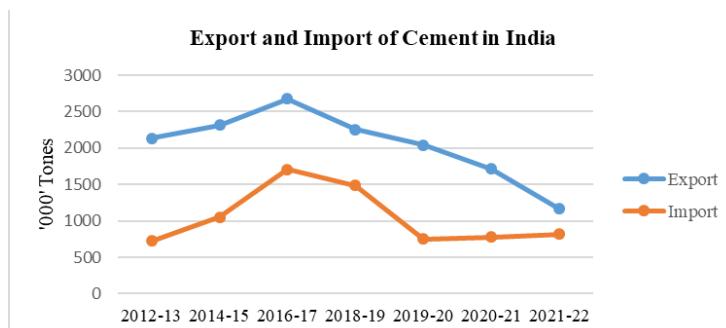
**Fig 1:** Relation between Production and Consumption of India**Fig 2:** Relation between Export and Import of India

Figure 1 depicts that production and consumption of cement is rising continuously. Figure 2 shows that export quantity of cement is higher than the volume of import. The gap between export and import was 1410 thousand tonnes in 2012-13, and only 350 thousand tonnes in 2021-22. Let the regression analysis be made between production, export and import of cement in India. The data of the concern variables are discussed in table 4, and 11. The production of cement is the dependent variable while the Export and import of cement are the independent variables. The data has been analysed on the basis of the information available from 2012-13 to 2021-22.

12 (a): Summary Output

Regression Statistics	
Multiple R	0.644476932
R Square	0.415350516
Adjusted R Square	0.248307806
Standard Error	31616.82227
Observations	10

Source: Calculated by Author.

12 (b): ANOVA Analysis

	df	SS	MS	F	Significance F
Regression	2	4971113275	2485556637	2.486492924	0.152803921
Residual	7	6997364155	999623450.7		
Total	9	11968477430			

Source: Calculated by Author.

Table (12-a) shows that R square is found to be 0.415350516, showing, that the degree of relation between the independent variable X and the dependent variable Y. Table (12-b) shows that p value (0.061) is higher than critical value at 5% level of significance ($p > 0.05$), therefore the null hypothesis-1 is accepted. The p value (0.315) is higher than critical value at 5% level of significance ($p > 0.05$), therefore the null hypothesis-2 is accepted. So, it is concluded that (a) there is no relation between production of cement and export of cement in India, and (b) there is no relation between production of cement and import of cement in India.

Cement Corporation of India Limited was incorporated on 18 January 1965 as a wholly owned subsidiary of the Government of India with the aim of achieving self-sufficiency in cement production. The authorised and paid-up capital of the company are Rs. 900 crores and Rs. 811.41 crores respectively. It is the sole public sector enterprise of the Government of India that manufactures cement. It has many offices and regional centres all over the India. The National Council for Cement and Building Materials which promotes research and development in the field of cement

industry and building materials, was established in 1962. The Indian cement industry faces many challenges, including environmental issues, land acquisition, and logistics. The industry is a major source of carbon emissions, and the government is implementing various measures to reduce the impact of the industry on the environment. Logistics management from raw materials to finished products are critical to the success of cement companies. However, logistics management can be a daunting task when faced with challenges like changing demand, supply chain disruptions, and transportation issues. Cement manufacturing emits greenhouse gases both through direct carbon dioxide production during thermal decomposition of calcium carbonate (acid and carbon dioxide) and through energy use (especially from the combustion of fossil fuels).

In India, the Bureau of Indian Standards (BIS) is liable for the components and implementation of various standards for services or products throughout industries. This helps in increasing the extent of play and knowledge of the product. Governments also can help remodel the financial system through public rules and low carbon usage. As a result, the Indian cement area has a vibrant future because of the government's efforts, infrastructure and monetary proliferation. MP Birla Cement gives the nice cement in India with its exceptional merchandise, reliability, commitment to innovation and purchaser-centric technique.

Conclusion

Cement is an important material used in the construction of roads, dams, power plants, buildings and factories. The story of growth of cement industry in India is sagacious. Started in 1904 with a small plant in Tamil Nadu, India has become second largest manufacturer of cement, having production capacity of 545 million tonnes. Share of India in global production of cement is increasing continuously.

In the above analytical study, certain indicators have clearly pointed out the challenges and promising future prospects of the cement companies in India. In spite of all the positive points, there is still a scope for betterment in some aspects. The Indian cement companies have to achieve higher share of sales in the market for which multi products like ready mix concrete, green cements and new building materials etc. should be produced. Though the above study is conclusive of the facts that the position of the Indian cement industry in the world ranking is much better than many of developed countries, yet there is still a scope for achieving the mile stone of becoming the largest manufacturer of cement in the world. The initiatives and announcements by government and consequent activity of related sectors including private sector will contribute towards India becoming a five trillion economy soon and cement industry will be a big contributor.

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