Case Report

Evaluating the Impacts of COVID-19 on the Maritime Sector: The Case of India

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The aim of this article is to examine the impacts that COVID-19 has over maritime sector and especially how it effects the sea transportation in India. In order to better appreciate resilience in the maritime industry, the study conducted secondary research to identify the impacts of COVID-19 in Indian economy, supply chain and crew changes. The COVID-19 pandemic had a tremendous impact on every aspect of our lives, including the maritime industry. This industry, which is responsible for transporting 80% of global, has been hit hard by the pandemic since 2020. From disruptions in the global supply chain to the global economy and crew changes, the impact of COVID-19 on the maritime industry has been unprecedented. This paper will represent the factors of the pandemic and how it has affected maritime. The study reckon that the contribution of this work will spread awareness to the public about the problem that has been created in the last three years.

1. Introduction

The COVID-19 pandemic had a significant impact on all aspects of our daily life, including transportation. This outbreak has caused unprecedented disruptions to transportation systems around the world, affecting the movement of people and goods[1][2][3]. Governments across the globe have implemented strict measures such as lockdowns, travel restrictions, and social distancing requirements to control the spread of the virus[4][5]. As a result, the need for transportation has decreased drastically, leading to reduced travel and transportation activities[6]. This has had profound effects on the transportation sector, causing significant economic, social, and environmental consequences[7][8].

To begin with, maritime transportation refers to the movement of goods, people, and cargo through the sea or ocean using ships and boats[9]. It is an essential mode of transportation for international trade and commerce, as well as for travel and tourism. Maritime transportation includes several types of vessels,

 doi.org/10.32388/HQFEW5

such as cargo ships, tankers, container ships, cruise ships, ferries, and fishing boats. These vessels transport goods, commodities, raw materials, and finished products across the globe, connecting different regions and countries[10][11]. Several studies award the advantages of maritime transportation. For example, is a cost-effective and efficient mode of transportation for bulk and heavy goods, especially for long distances. It is also a more environmentally friendly mode of transportation compared to air or road transport, as it produces lower emissions and has a lower carbon footprint[12][13][14].

Maritime transportation plays a crucial role in the global economy. It is carried approximately 80% of global trade and is a cost-effective and reliable mode of transportation for goods and products around the world[6]. The global economy relies heavily on maritime transportation for the movement of goods and products between different countries and regions[15]. The shipping industry is responsible for facilitating the international trade that drives economic growth and development[6]. Any disruption to maritime transportation, such as port closures or supply chain disruptions, in our case caused by pandemic, can have significant impacts on global trade, leading to higher costs for businesses and consumers, and potentially even leading to economic recessions[16][17]. However, the COVID-19 pandemic had a significant impact on the maritime industry in numerous ways[15].

The aim of this study, is to examine the impacts that COVID-19 has over maritime sector and especially how it effects the sea transportation in India. In order to better appreciate resilience in the maritime industry, the study conducted secondary research and case study analysis, to identify the impacts of COVID-19 in Indian economy, supply chain and crew changes. The structure of the paper is the following: Section 2 presents the theoretical background, focusing on the COVID-19 on maritime sector, while section 3 is related with the methodology.

2. Theoretical background: COVID-19 and Maritime Sector

COVID-19 has had a significant impact on various aspects of society, including the maritime industry[18]. As a highly contagious virus, COVID-19 has presented unique challenges for the maritime sector, affecting seafarers, ports, shipping operations, and global trade[19][20].

One of the serious issues faced by the maritime industry during the COVID-19 pandemic has been the welfare of seafarers[21][22][23]. Seafarers play a crucial role in global trade, as they operate and maintain ships that transport goods across the world[24]. However, due to travel restrictions, crew changes have become increasingly difficult. Many seafarers have been stuck onboard vessels for extended periods,

exceeding their contractual agreements and facing mental health challenges[25]. The inability to rotate crews has raised concerns about fatigue, safety, and the well-being of seafarers[26]

Additionally, maritime ports have been significantly affected by COVID-19. Ports serve as vital gateways for international trade, but they have had to adapt to new health and safety protocols to prevent the spread of the virus. Measures such as health screenings, mandatory quarantine periods, and social distancing have been implemented to minimize the risk of transmission among port workers and visiting crews[18][27]. These measures have caused delays in cargo handling, port congestion, and disruptions to supply chains, impacting global trade flows[1]. Furthermore, shipping operations have been affected by changes in consumer demand and disruptions to global supply chains[28][29]. As countries implemented lockdowns and restrictions, the demand for certain goods fluctuated dramatically. For instance, the demand for medical supplies and essential goods increased significantly, while the demand for non-essential items, such as luxury goods, declined[1]. Shipping companies had to adjust their operations, accordingly, redirecting vessels to meet changing demands and ensuring the delivery of critical goods[18][30].

International regulations and guidelines have also been put in place to address the challenges faced by the maritime industry during the pandemic[31]. Organizations like the International Maritime Organization (IMO) have issued guidance to ensure the safe operation of ships, facilitate crew changes, and support seafarers' well-being[32][33]. Efforts have been made to classify seafarers as key workers and facilitate their travel, allowing crew changes to occur in a timelier manner[34]. Moreover, the pandemic has accelerated the adoption of digital technologies in the maritime industry. Remote working, online documentation, and digital communication platforms have become more prevalent to minimize physical interactions and enhance efficiency. Digitalization has played a crucial role in facilitating business continuity and ensuring the smooth operation of maritime activities during these challenging times[35][36].

Looking ahead, the maritime industry continues to face uncertainties as the COVID-19 situation evolves[1]. Collaboration among governments, international organizations, and industry stakeholders remains crucial to address the ongoing challenges, ensure seafarers' well-being, and maintain the flow of global trade[34]. The lessons learned from this pandemic are likely to shape future strategies, with a focus on resilience, contingency planning, and the prioritization of seafarers' rights and welfare in the maritime sector[24].

3. Methodology

The present study relies on the secondary data to make an impact assessment of COVID-19 on maritime industry, especially on the ports of India. To conduct the research, we used the case study method. A case study is a research method used in various disciplines, including business, social sciences, medicine, and psychology[37][38]. It involves an in-depth examination and analysis of a particular individual, group, event, organization, or phenomenon. The primary aim of a case study is to understand and explore complex issues within their real-life context. In a case study, researchers gather detailed information through various data collection methods such as interviews, observations, surveys, documents, and archival records[39]. They typically focus on a specific case or a small number of cases to provide a rich and comprehensive analysis. Case studies often employ a qualitative approach, although quantitative data may also be incorporated[40][41]. Researchers delve into the case's background, explore its intricacies, analyze relevant factors, and interpret the findings to draw insights and conclusions. The analysis may involve identifying patterns, examining causal relationships, describing processes, or evaluating outcomes. Case studies are valued for their ability to provide a holistic and nuanced understanding of complex phenomena, allowing researchers to explore real-life situations in depth[42][43]. They can provide valuable insights, generate hypotheses, or serve as illustrative examples for theory development or practical applications[37]. Case studies are commonly used to investigate unique or rare occurrences, examine exceptional cases, or provide an in-depth exploration of a specific issue.

4. Indian economy

The COVID-19 has had a profound impact on the global economy, affecting virtually every aspect of business and commerce worldwide. The pandemic has caused a significant decline in economic activity, with numerous industries and sectors experiencing significant losses. The pandemic has not only affected the health of millions of people but has also affected the economy in many ways. The Indian economy, which was already struggling before the virus spread around, has been hit hard by the virus, and it has caused a significant slowdown in economic growth[44][45][46].

The Indian economy, which was already facing challenges such as unemployment, low GDP growth, India's GDP dropped by 7.3% for the whole 2020/21 financial year – the worst yearly economic contraction in the country's history[47] has been severely impacted by COVID-19. Figure 1 presents the course of the GDP of India from 2011 onwards[48]. As it clear, GDP will plummet from 2019, an event that is

perfectly connected to the spread of Covid-19[49]. The virus has caused disruptions in all sectors of the economy, including agriculture, manufacturing, services, and tourism. The strict lockdowns imposed to control the spread of the virus have led to a significant decline in economic activity, resulting in a recession[50]. One of the sectors that has been most affected by the pandemic is the informal sector. The vast informal sector, which contributes over 45% to India's GDP, has been hit hard by the pandemic[50]. The hospitality and travel industries have also been severely impacted, resulting in massive job losses[51][52].

The COVID-19 pandemic had a significant impact on the financial markets in India. When the pandemic first hit in early 2020, Indian markets experienced significant volatility, with steep declines in stock prices and bond yields[53][54]. Many businesses struggling to stay afloat. This had a ripple effect on the financial markets, as investors have become more cautious and risk averse[50].

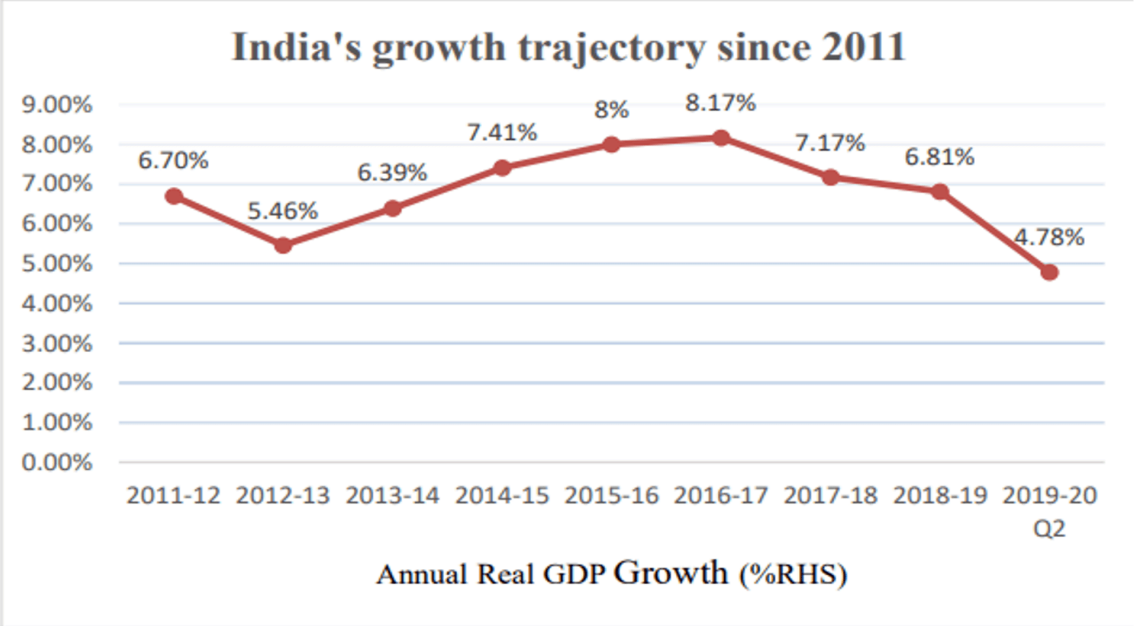

Figure 1. India's growth trajectory since 2011. Source: Agrawal et al[48]

China has profoundly altered the landscape of Indian markets engaged in various commodities such as precious stones and adornments, aquatic edibles, and chemical derivatives. The eruption of the Covid-19 pandemic has cast a detrimental influence on China's export activity[55][56]. To elucidate, the fishing industry is anticipated to suffer a financial setback exceeding 1300 crores, attributed to the dwindling

export numbers. Notably, India dispatches 36 percent of its diamond produce to China. The city of Jaipur has encountered substantial fiscal losses in the range of 8000-10000 crores, stemming from the annulment of four key trade expos spanning February to April. Further, 34% of India's petrochemicals find their way to the Chinese market[55]. However, due to prevailing export constraints, a decline in the price of petrochemical commodities is envisaged. The COVID-19 pandemic has translated into a trade impact of approximately USD 348 million for India, according to the UNCTAD report. As a corollary of China's manufacturing deceleration casting a shadow over global trade, India finds itself ranked among the top 15 economies negatively impacted. Within the Indian context, the comprehensive repercussions on business are itemized in the ensuing.

On the occasion when Prime Minister Narendra Modi initially announced the 21-day lockdown, he also cautioned about the impending adverse economic repercussions, indicating that we would bear the consequences. The All India Association of Industries (AIAI) approximated a financial loss of $640 million for the Indian economy, with projected growth expected to range between 5 to 5.6% until 2022[57]. Following the conclusion of the initial lockdown phase, within a span of 7 days, there was a 30% reduction in electricity demand, a 5% decrease in port traffic, a 70% decline in oil demand, and Indian railway activity dwindled to below 36% when compared to the previous year. Subsequently, the unemployment rate surged to 19% within a month of the lockdown, and by April 24, overall unemployment across India had reached 26%. Consequently, the lockdown wreaked havoc on businesses of all sizes throughout the country, resulting in widespread job losses and a state of economic downturn[57].

The government of India has taken several steps to mitigate the impact of COVID-19 on the economy. One of the significant steps taken by the government is the announcement of a stimulus package worth Rs. Three trillion collateral-free bank loans to MSMEs with 100% credit guarantee[50]. The National Credit Guarantee Trust Company Limited (NCGTC) will furnish the assurance. Furthermore, this package includes measures such as loans, liquidity support, and tax incentives to support businesses and revive economic growth[50].

Another sector that has been hit hard by COVID-19 is manufacturing. The pandemic has disrupted supply chains, resulting in a shortage of raw materials, which has led to a decline in production[58][44]. The manufacturing sector has also been impacted by the reduction in demand due to the economic slowdown caused by the pandemic[50][59]. The agriculture sector, on the other hand, has not been as affected by the

pandemic as other sectors. However, farmers have been facing challenges due to disruptions in the supply chain, resulting in a decline in prices of agricultural products[60][61].

However, there are still concerns about the impact of the pandemic on the Indian economy and financial markets in the long term. The pandemic has highlighted structural weaknesses in the Indian economy, such as a lack of adequate healthcare infrastructure, limited social safety nets, and a large informal sector.

5. India's maritime sector

India's maritime sector, like many other sectors, was significantly affected by the COVID-19 pandemic. Here are some key aspects of India's maritime industry and its experiences during this challenging time.

5.1. Crew change crisis

The COVID-19 pandemic has affected every aspect of human life, and the shipping industry is no exception. One of the major challenges faced by the shipping industry during the pandemic has been the crew change crisis. The situation has been particularly acute in India, which is one of the world's largest suppliers of seafarers[62][63] At the peak of the crew change crisis in October 2020, 400.000 seafarers were stranded at sea due to COVID-19 border closures[34]. Crew change refers to the process of exchanging crewmembers on board a vessel when their contract is up or when they need to be relieved due to personal reasons[34]. Due to various COVID-19 related travel restrictions and quarantine measures imposed by many countries, crew change has become a major challenge for the shipping industry. Many seafarers have been stranded on ships for extended periods beyond their original contract, causing significant stress and fatigue[26].

Seafarers are essential to the shipping industry, as they are responsible for the safe and efficient operation of ships. However, due to the COVID-19 pandemic, crew changes have become a significant challenge. The crew change crisis has had a significant impact on seafarers and their families[62] [24] Many seafarers have been stranded on board their vessels for months beyond their original contracts, unable to return home due to travel restrictions and quarantine measures[34]. This has led to mental health issues and physical exhaustion for seafarers, as well as difficulties for their families back home. Further, researchers have identified that the impacts of global economic recession, unemployment and uncertain future of their families are key factors of anxiety and mental health exhaustions[26].

Figure 2 provides a visual representation of the prevalence of mental health aspects, as evaluated through the DASS-21 scale, within the seafaring community. Within this population, we observed that 16.9% exhibited symptoms indicative of moderate depression, 15.6% displayed signs of moderate anxiety, and 5.2% reported experiencing severe stress[64]. Notably, this investigation revealed that the current health status of seafarers and alterations in their family's income due to the COVID-19 pandemic exhibited statistically significant associations with depression. Additionally, extensions in contract periods during the pandemic, shifts in overall household income, and the inability of seafarers to meet their expenses all demonstrated statistically significant connections with anxiety levels[64]. Furthermore, seafarers who engaged in part-time employment to supplement their income and those lacking insurance coverage displayed statistically significant associations with elevated stress levels [65]. These findings underscore the complex interplay of socio-demographic factors and mental health outcomes among seafarers in the context of the COVID-19 pandemic[64].

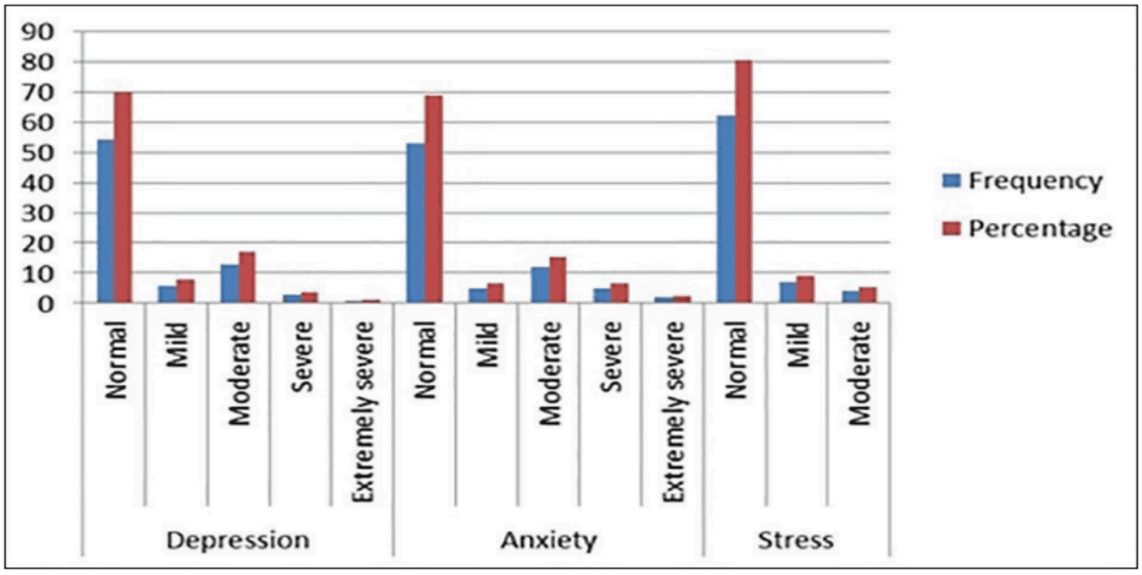

Figure 2. Incidence of Depressive, Anxious and Stressed states. Source: Kaur and Joy[64].

The mission also found that the increased workload experienced by seafarers due to the need for more thorough cleaning and disinfection protocols, along with uncertain economic prospects, is causing psychological stress. This has been highlighted by the Mission to Seafarers in 2020[26]. Additionally, scholars have pointed out that the global economic downturn, rising unemployment rates, and the uncertain future faced by their families contribute significantly to feelings of anxiety and mental

fatigue[63]. Various researchers[26][66][67] have substantiated these assertions. To support these claims, researchers have provided data indicating that over 40% of respondents, specifically 269 out of 671 participants, have reported experiencing symptoms of depression multiple times, nearly every day, or within the past week[63]. Furthermore, more than half of the respondents have encountered symptoms of anxiety[26]. Table 1 illustrates the proportion of seafarers in the sample who continue to serve on vessels beyond their contract expiration and the number of seafarers who have been onboard for more than 11 months. The Neptune Declaration Crew Change Indicator, which draws data from 10 ship managers overseeing over 100,000 seafarers across various sectors, offers reliable insights into crew change challenges. Initially launched on a monthly basis starting in May 2021, the Neptune Indicator transitioned into a quarterly publication in July 2022. The data for the first quarter of 2023 reveals a decrease in the percentage of seafarers from the sample who remain onboard vessels beyond their contract expiration, declining from 2.7% to 2.2% since January 2023. However, the percentage of seafarers onboard for over 11 months has remained unchanged at 0.2% since January 2023.

	Percentage of seafarers onboard beyond the expiry of their contracts		Percentage of seafarers onboard for over 11 months	
	Monthly percentage	Percentage point change from previous month	Monthly percentage	Percentage point change from previous month
April 2023*	**2.2%**	**-0.5**	**0.2%**	**0**
January 2023*	**2.7%**	**-0.6**	**0.2%**	**-0.1**
October 2022*	**3.3%**	**-0.9**	**0.3%**	**0**
July 2022	**4.2%**	**-0.1**	**0.3%**	**0**
June 2022	**4.3%**	**-0.2**	**0.3%**	**0**
May 2022	**4.5%**	**+0.3**	**0.3%**	**-0.1**
April 2022	**4.2%**	**-0.8**	**0.4%**	**0**
March 2022	**5.0%**	**+0.8**	**0.4%**	**0**
February 2022	**4.2%**	**+0.5**	**0.4%**	**0**
January 2022	**3.7%**	**-1**	**0.4%**	**-0.3**
December 2021	**4.7%**	**-2.4**	**0.7%**	**-0.3**
November 2021	**7.1%**	**-0.8**	**1.0%**	**0**
October 2021	**7.9%**	**-1.0**	**1.0%**	**-0.2**
September 2021	**8.9%**	**-0.1**	**1.2%**	**-0.1**

Table 1. Percentage of seafarers on board beyond the expiry of their contracts and for them who stay on board for over eleven months. Source: Agrawal et al.[48]

The crew change crisis refers to the difficulties faced by seafarers in disembarking and returning home after their contracts on ships have ended, and by those waiting to join ships to start their contracts[63]. Due to the pandemic, travel restrictions and border closures have made it extremely difficult for seafarers to transit through airports and other transportation hubs, leading to a backlog of seafarers waiting to join or leave their ships[24]. This has created a humanitarian crisis, with seafarers being stranded at sea for extended periods, beyond their contracts[26].

In India, the crew change crisis has been particularly acute, as the country has been one of the hardest hit by the pandemic. The Indian government has imposed strict restrictions on travel, making it difficult for seafarers to travel to and from ships[26]. In the other hand, to address the crew change crisis, the Indian government has issued various advisories and guidelines, including allowing chartered flights and special visa exemptions for seafarers, creating designated quarantine facilities for seafarers, and establishing a digital platform to facilitate crew changes. The maritime authority in India has created a user-friendly electronic travel pass module known as the e-pass module, designed to facilitate the seamless issuance of digital passes for seafarers[68]. These passes enable seafarers to travel without restrictions during lockdown periods, whether it be for boarding a ship from their place of residence or for returning to their residence from a port or airport after signing off. The online process ensures a quick and convenient experience for seafarers[26]. The neglect of sailors has emerged as a significant issue amid the pandemic, illustrated by instances such as that of a Spanish vessel with 15 crewmembers. Several governments, including the Indian Government, have initiated efforts to bring back their sailors, with India successfully repatriating 20,000 seafarers in three stages by May 2020[24]. The International Transport Workers' Federation (ITF), a global representative body for seafarers, has urged for the fair treatment and protection of these frontline workers, akin to other frontline workers. Additionally, it has highlighted concerns about the closure of embassies in various countries, depriving seafarers of vital assistance while in ports[69] Despite these efforts, the crew change crisis in India and around the world continues to be a pressing issue, with many seafarers still waiting to join or leave their ships[68]. The ongoing pandemic and associated travel restrictions continue to make it difficult for seafarers to carry out their essential work and for the maritime industry to function effectively[24].

The crew change crisis has also had significant economic implications for the industry. Delays in crew changeovers can result in increased costs for shipowners and operators, as well as lost revenue due to delayed voyages[26][25]. It can also have a ripple effect on global trade and supply chains, which rely

heavily on maritime transport. To address the crew change crisis in India, various measures have been taken. The Indian government has designated seafarers as essential workers and has established protocols for crew changes[24]. The government has also allowed seafarers to travel to and from ports, subject to strict health and safety protocols.

The global community, represented by organizations like the International Maritime Organization (IMO), International Labor Organization (ILO), World Health Organization (WHO), and International Civil Aviation Organization (ICAO), along with other key players in the maritime sector, including the International Chamber of Shipping (ICS) and the International Transport Workers' Federation (ITF), have come together in light of the pandemic's impact[26]. This pertains to the challenges faced by seafarers who find themselves stranded on vessels for extended contractual periods due to border closures[18]. These entities have united their efforts to tackle the issues within their respective scopes of authority. Their collaborative response aims to ensure the provision of comprehensive and effective guidance to governments and all stakeholders involved in the maritime industry[26]. Responding to the appeals from Member States for standardized recommendations concerning certain matters, the International Maritime Organization (IMO) had issued 23 Circular Letters by 25 June 2020, addressing the repercussions of the pandemic. These correspondences encompass collaborative statements with other United Nations (UN) agencies, alongside directives disseminated by the maritime industry[26]. The organization also ensured the worldwide dissemination of pertinent guidance and information, establishing a dedicated Seafarer Crisis Team. On 20 April 2020, the Secretary-General of the IMO penned letters to all Member States, urging them to acknowledge seafarers as essential "key workers," eliminate bureaucratic hurdles to their documentation, and lift travel constraints to enable their timely return home upon the expiration of their work contracts, reuniting them with their families[26]. In his correspondences on this matter, the IMO Secretary-General underscored two pivotal concerns:

1. The imperative that maritime trade flow remains uninterrupted wherever feasible, while concurrently upholding utmost regard for maritime safety and environmental preservation.
2. The significance of acknowledging the plight of hundreds of thousands of seafarers aboard vessels inadvertently thrust onto the front lines of the global pandemic.

Their dedication ensures the safe and environmentally conscious delivery of indispensable goods. These individuals, often far from their homes and loved ones, warrant the same level of concern for their health and well-being as anyone else.

On 8 June, the IMO Secretary-General, alongside the Secretary-General of the United Nations Conference on Trade and Development (UNCTAD), urged governments to facilitate crew changes and safeguard crew welfare by expediting repatriation and ensuring the secure return of seafarers, marine personnel, fishing vessel personnel, offshore energy sector personnel, and service provider personnel at ports, recognizing them as indispensable "key workers" delivering essential services, irrespective of nationality while within their jurisdictions, and exempting them from travel constraints[68] They stressed that such recognition would safeguard the unimpeded flow of critical goods, including medical supplies and food, amidst the pandemic and associated containment measures. They advocated for a pragmatic and practical approach towards crew rotations, resupply operations, vessel repairs, inspections, and the certification and licensing of seafarers[69].

Overall, the COVID-19 pandemic has had a significant impact on the Indian economy and the workforce. While some sectors have been heavily impacted, others have seen opportunities for growth and innovation. The long-term effects of these changes on the Indian economy remain to be seen.

5.2. Supply chain

The COVID-19 pandemic has caused unprecedented disruptions to global supply chains, and India's maritime sector has not been immune to its far-reaching effects[70]. As an essential contributor to India's trade and economy, the maritime supply chain has faced numerous challenges and had to adapt swiftly to ensure the smooth flow of goods amidst the crisis. In this paper, we explore the impact of COVID-19 on India's maritime supply chain and the measures taken to mitigate disruptions[15]. With the enforcement of lockdown measures and the closure of borders in various nations, there was a substantial limitation on the mobility of individuals and the transportation of goods worldwide. Ports were closed, ships were detained, and cargo was stranded, causing massive delays and losses for the industry. The disruption also led to shortages of essential goods such as medical supplies and food[1]. The pandemic had a tremendous impact on supply chains in India. The extensive turmoil brought about by the pandemic has resulted in significant disruptions to supply chains within the nation[15]. The Indian government, along with businesses and supply chain experts, has been working tirelessly to mitigate the effects of the pandemic on the country's supply chain[26]. One of the most significant challenges faced by the supply chain in India during the pandemic has been the disruption of logistics and transportation networks[15]. With many cities and states implementing lockdowns and restrictions on movement, the movement of goods

across the country has been severely impacted. This has resulted in delays in delivery and increased transportation costs[71].

Figure 3 illustrate the shipping operations and operational logistics issues due to the Covid-19 pandemic in India[72]. As is evident, the biggest problem has been created in the field of labor issues and it reaches a percentage of 91.95%. In the series, they follow equally with a very high percentage of 89.66% the Volume Decline and the Operation Delays with 85, 06%. We will observe the least rates on Poor Infrastructure and Communication issues with 12, 64%.

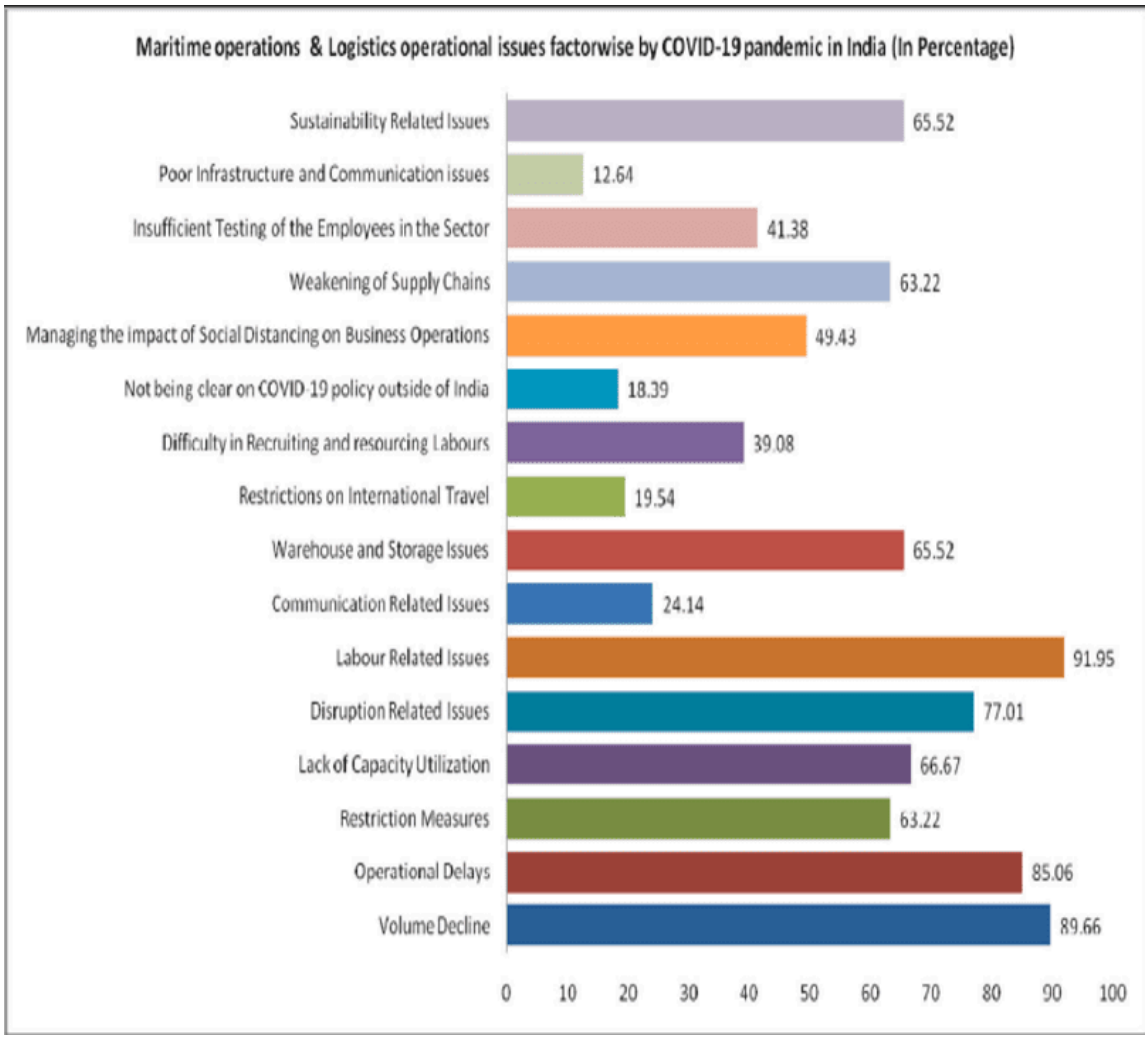

Figure 3. Maritime operations & Logistics operational issues factorwise by COVID-19 pandemic in India.

Source: Agrawal and Singh[55]

5.3. Maritime transport and logistics sector

The disruptions caused by the COVID-19 pandemic in transportation and logistics systems necessitated robust reactions to alleviate the supply chain disruptions (SCDs) in India. One potential response could involve fully restoring shipping and port operations to their pre-pandemic levels[71]. India's maritime sector had actively engaged in global trade, serving as a link between the domestic and international markets. The extensive lockdown measures led to significant vulnerabilities in transportation and unforeseen contractions in supply and demand. Consequently, this led to a reduction in shipping demands and port activities[71][73].

Figure 4 demonstrates a negative trajectory in both overseas and domestic cargo flows from April to December 2019-2020 to April–December 2020–2021. The total cargo traffic exhibited a decline of 9%, with coastal cargo experiencing a substantial reduction of 15.1% when contrasted with overseas cargo within the same timeframe[71]. Hence, the restrictions imposed by the COVID-19 pandemic have profoundly impacted cargo traffic volumes at the twelve major ports across India[15]. The disruptions in shipping have intertwined with interruptions in road and air freight transport, resulting in significant supply chain disturbances. For instance, over 50,000 sea containers remained uncleared at 23 Container Freight Stations and private container terminals in major ports like Chennai, Kamajarar, and Kattupalli[71]. This was mainly due to the absence of road transportation options and a lack of clear supply chain visibility stemming from the pandemic[71].

As a result, the reduction in cargo traffic volumes has not only affected other modes of transport but has also severely disrupted supply chains[70][74]. This disruption had cascading effects, including short-term consequences such as decreased production, supply chain breakdowns, logistical confusion, and decreased offline consumption. Furthermore, it had medium to long-term implications, such as reduced demand for raw materials, declining demand and consumption, diminished merchandise trade, and significant supply chain disturbances.

The COVID-19 pandemic has presented significant challenges for India's maritime industry, including disruptions in the supply chain, labor shortages, and increased shipping costs. However, the industry has shown remarkable resilience, with ports and logistics facilities implementing safety measures and the government providing financial relief. The maritime industry is critical to India's economic growth, and it is essential to continue supporting it during these challenging times.

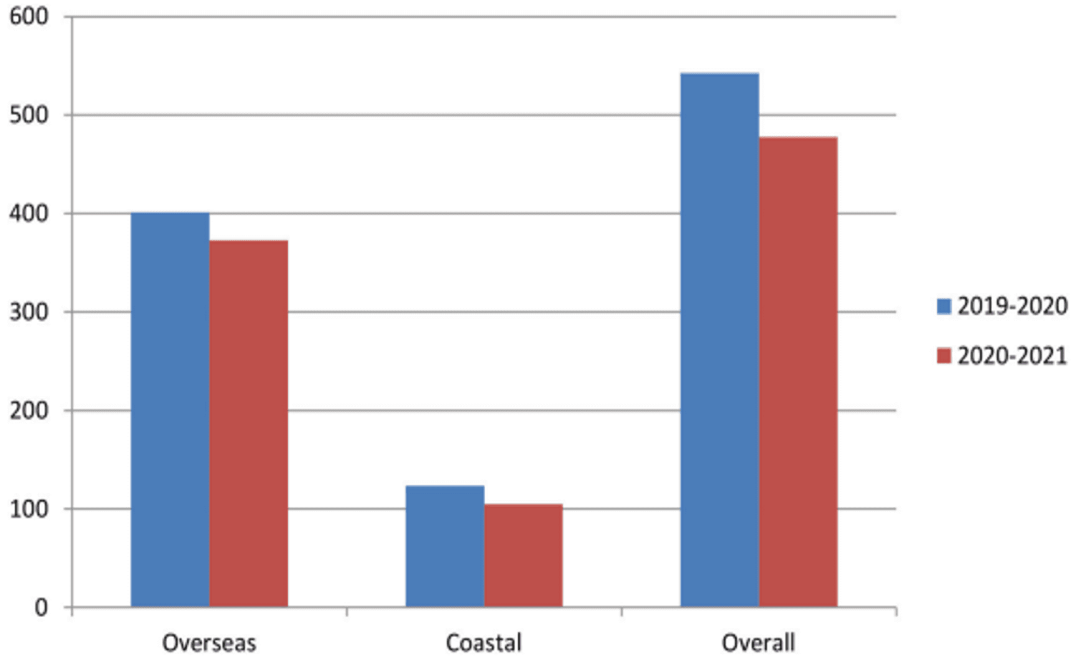

Figure 4. Comparison of port cargo traffic trends between 2019-2020 & 2020-2021. Source: Sudan and Taggar[71].

6. Conclusion

The maritime sector in India faced significant challenges during the COVID-19 pandemic. The outbreak of the virus and the subsequent global lockdowns disrupted the normal functioning of the maritime industry, leading to a decline in trade activities and severe economic implications. However, despite the adversity, the sector exhibited resilience and adaptability, implementing various measures to ensure the smooth operation of essential services and mitigate the impact of the pandemic.

One of the key challenges faced by the Indian maritime sector was the disruption in global supply chains. As countries imposed restrictions on movement and international trade, shipping activities were severely affected. Ports experienced reduced cargo volumes, delayed shipments, and logistical complications. This disruption had a cascading effect on various industries, including manufacturing and export-import. The Indian government took proactive steps to address the challenges faced by the maritime industry. They introduced policies and protocols to ensure the safety of the seafarers and port workers, implementing stringent health and hygiene measures at ports and on vessels. Special protocols were established for crew changes and repatriation, enabling the seamless movement of seafarers. To revive the maritime

sector, the Indian government announced stimulus packages and provided financial support to ports and shipping companies. Initiatives such as extended free storage time, relaxed demurrage charges, and reduced port tariffs were introduced to alleviate the financial burden on the industry. Additionally, digitalization and automation gained momentum during this period, facilitating contactless operations, and ensuring business continuity.

Additionally, the COVID-19 pandemic has significantly impacted maritime crew changes in India. The global health crisis brought about unprecedented challenges, including travel restrictions, quarantine protocols, and reduced transportation options, which had a profound effect on crew rotation and seafarer welfare. India, being a major supplier of seafarers to the international maritime industry, faced numerous hurdles in facilitating crew changes during the pandemic. Stringent lockdown measures, both domestically and internationally, limited the movement of seafarers, leading to extended contracts and prolonged periods spent at sea. This situation resulted in physical and mental strain for seafarers, who were unable to reunite with their families and faced increased fatigue and stress. To address these issues, the Indian government, in coordination with international organizations and shipping companies, implemented various measures to facilitate crew changes and prioritize seafarer well-being. They established standard operating procedures, introduced digital platforms for documentation and certification, and initiated "green lanes" to expedite crew transfers at airports and seaports. These efforts aimed to ensure the safe repatriation of seafarers and the efficient embarkation of new crew members.

In conclusion, the maritime crew changes in India during the COVID-19 pandemic have been marked by significant challenges, but also by collective efforts to address them. The lessons learned from this experience will undoubtedly shape the future of crew changes and reinforce the commitment to seafarer welfare in the maritime industry.

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Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.