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Appraising the impact of COVID-19 on trading volume of selected vessel types in sub-Saharan Africa

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Abstract

The emergence and diffusion of coronavirus (COVID-19) have brought a lot of impacts on various spheres of human endeavours including maritime trading. This paper explores the effect of the lockdown on maritime port calls for selected vessels in the sub-Saharan African (SSA) regions (East, Middle, South, and West Africa). The study utilizes port calls data of the maritime profile of the global economies obtained from the United Nations Conference on Trade and Development Statistics between 2018 and 2021. Data include port calls for liquid bulk carrier, liquefied petroleum gas, dry bulk carrier, dry break bulk carrier, roll-on-roll-off, and container carrier. The analysis of data involves the use of exploratory technique to reveal dimensions of performance by various carriers across the regions. The results picture the kind of response of port calls in all the regions akin to the response from other regions of the world. However, the study observes that though responses to COVID-19 lockdown across the globe were similar, SSA regions were slow in recovering from the decline in port calls when compared to the developed and some rapidly developing economies of the world due to the region's lack of economic resilience. Thus, since ports have been identified as vulnerable to economic, social, institutional, and environmental shocks, and to dynamic and highly unpredictable demand for port services, policymakers of various nationals in the SSA may need to examine the patterns of performance of vessels in the regions to manage trade flows more effectively as a way of responding to future dynamics in maritime trade in the region.

Keywords: COVID-19, Sub-Saharan Africa, Port calls, UNCTAD, Maritime trade

Introduction

The COVID-19 pandemic caused a crisis in the global economy on an unprecedented scale and range. This crisis also affected global seaports being an important link in maritime supply chains. This important feature makes maritime port performance and resilience crucial to sustaining global economic growth (Wan et al. 2016, 2021). Despite ports' significant attribute to global maritime trade prosperity, the port ecosystem is affected by a broad range of economic, social, institutional, and environmental trends and shocks, and predominantly by a dynamic and highly unpredictable demand for port services. Undoubtedly, ports provide a system whose interruption or disruption

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may provide a resonant catastrophe across the globe, especially in terms of economic, social, and political losses; the consequence of which may sometimes be irreversible, especially for the affected port(s). Studies have reported various disruptions to port operations. These range from man-made events (e.g. terrorist acts, workers' strikes) to natural calamities (Hosseini et al. 2019; Stecke and Kumar 2009; Park et al. 2008; Chang 2000). In recent times, the emergence of Covid-19 with its pervasive global health and socio-economic crisis has profoundly impacted virtually all facets of human lives (Perillo et al. 2021; Armenio et al. 2021). The Coronavirus 2019 (COVID-19) pandemic represents one of the major disruptions encountered during the last decades with far-reaching economic consequences especially because of its highly contagious nature (Zaremba et al. 2020; Zhang et al. 2020) which led major countries and territories of the world to spell out measures to contain the spread of the disease. Specifically, since the port is an important import and export channel with a high risk of transmission, an increasing number of countries decided to take strict measures to reduce the spread of COVID-19 associated with importing and exporting goods via the seaports (Notteboom et al. 2021). Such measures included among others, movement restriction or lockdown orders and other personal protection measures, all of which had wide-ranging and severe economic impacts. At the beginning of the pandemic, trade impacts across specific goods, services, and trade partners were highly diverse. According to OECD (2021), the year 2020 was marked by some of the largest reductions in trade and output volumes since World War II. Specific manifestations include declining shipping capacity, port congestion, lower container turnover, soaring freight rates, and container shortages. These factors increase the variability in international trade and cargo volumes in ports. By December 2020, the global schedule reliability of shipping has hit the lowest point of 44.6% since 2011(Jin et al. 2022). The reduction in maritime traffic caused a significant blow to shipping networks, particularly the security and stability of the global supply chain system (Jiang et al. 2021). The reduction in international trade between export and import volumes during the pandemic is distributed unevenly in space and across different periods.

In Africa, for instance, though the pandemic arrive a little late, significant setbacks were witnessed in African economies, especially in terms of loss of productivity and shrunken regional and international commerce. More specifically, the setbacks were obvious in the maritime sector where there was a significant overall decline in the number of port calls and volumes of goods traded in most sub-Saharan African (SSA) ports. The decline was explained by blank sailings on a scheduled route, due to insufficient traffic. This experience brought with it a declining fortune for the sub-region whose contribution to global merchandise by value is about 2.5% of exports and 3% of imports in 2020. According to UNCTAD (2021), SSA presents a region with countries worst hit during the first wave of the pandemic in 2020 as ship calls in the region dropped by 9.7%, causing African trade to shrink by 30%. As a result, the study seeks to know how many were vessel calls affected at sub-Saharan African ports. And what was the recovery rate of the vessel calls at sub-Saharan African ports? Thus, the paper examines the impacts of the COVID-19 pandemic on selected vessel calls at SSA ports to determine temporal changes recorded between the period preceding the emergence of the pandemic and the period of subsidence of the pandemic. Investigating the impacts of the COVID-19 pandemic on port calls in the regions of sub-Saharan Africa is significant because SSA

handled about 817 million tones of the 1.25 billion tones of maritime trade processed in Africa.

The remainder of the paper is organized as follows. Section "Literature review on the impact of COVID-19 on the maritime sector" presents the literature review of the impact of COVID-19 on the maritime sector. Section "Study method" illustrates the methodology adopted in the present study, including the study area and selected vessel types for analysis. Analysis of the selected vessel types supply chains—i.e., liquid bulk carrier, liquefied petroleum gas carrier, dry bulk carrier, dry break bulk carrier, roll-on-roll-off, and container carrier is provided in section "Results". Section "Discussion" discusses the results of the analysis, whereas section "Conclusion" provides some conclusions and suggestions for future research.

Literature review on the impact of COVID-19 on the maritime sector

Research has been carried out on various challenges posed by the emergence of the Covid-19 pandemic such as the reduction of maritime traffic, changes in port services, and cargo congestion (Chinazzi et al. 2020; Menhat et al. 2021). Yazir et al., (2020) highlighted the effect on time spent by ships at berth as well as the declining efficiency of workers, how to deal with a series of threats and challenges brought by COVID-19, especially port congestion. Whereas, Gui et al. (2022) in a similar study, using Analytical Hierarchy Process (AHP) to analyze port congestion found that supply chain disruption and shortage of human resources to handle cargo handling activities were the key factors of congestion during the pandemic. There are also studies on the impact of covid-19 on declining port revenue, declining port competitiveness, and increasing debt profile of ports (Saeed et al. 2018; Su et al. 2022). For the quantification of the impact of COVID-19, Xu (2021) constructed a panel regression model to analyze how the macroeconomy, the severity of the epidemic, and government control measures affect port operations.

In addition, Michail and Melas (2020) investigated the impact of COVID-19 on the shipping market. Using GARCH regression and impulse response of the value-at-risk model, they were able to provide evidence of the negative impact of COVID-19 on dry bulk and crude oil vessels. In a similar vein, Xu (2021) constructed a panel regression model to analyze how the macroeconomy, the severity of the epidemic, and government control measures affect port operations. Changes in the maritime network before and after the COVID-19 outbreak were also investigated by Guerrero et al. (2022) to reveal the relative impacts the mitigation measures by the government would have on different levels of ports. Failure of important nodes in the international liner network caused by COVID-19, which will cause container traffic fluctuation and ship freight supply mismatch was also investigated by Peng et al. (2022). Using AIS data, Peng et al. (2022) observed that fluctuations in the number of port ships have affected the number and results of inspections undertaken by the International Maritime Organization and the special inspection arrangements for port state control agreed in the Memorandum of Understanding (MoUs) worldwide.

Studies on multiple attempts of understanding the resilience of the overall logistics network were also proposed for better adapting infrastructure and services to the possible impact of external shocks especially in terms of how the different roles of ports in the regional economies could determine asymmetric impacts of network disruptions,

with related effects on the logistics processes (Calatayud et al. 2017, pp. 195–208; Wang et al. 2021; Zhang et al. 2022). Similar studies include Viljoen and Joubert's (2016) study on how maritime networks are generally resilient to shocks though with extra costs for users or increase flexibility of carriers depending on the specific network hierarchization and on the level of connectivity of the different ports and Vonck and Notteboom (2016) study on how seaports are complex adaptive systems and how their level of resilience is dependent on the capability of different stakeholders to adapt to the changing market environments. As such, understanding better if (and how) the pandemic shifted the cargo traded by different national ports could help in assessing the resilience of current logistics solutions, hopefully leading to a better response in case of future shocks.

While it is undoubtedly significant to understand that literature is replete with information on the effects of COVID-19 across all human facets, it is more pertinent to understand its disruptive influence on port calls which predetermines trade flows with associated logistics and supply chains. The majority of studies on COVID-19 and the maritime trade nexus have focused greatly on ports of developed economies or the developed ports of developing economies. This present study, which represents the first of its kind on how a pandemic affected the trade volume of sub-Sharan African ports, sets out to explore how COVID-19 affected the number of port calls across the regions of sub-Saharan Africa with the sole aim of determining the rate of influence of the pandemic on various port calls in the region to suggest response strategies for governments and other ports stakeholders in SSA for driving-related occurrences in the future.

Study method

The study covers four economic sub-regions of sub-Saharan Africa—East Africa, Middle Africa, South Africa, and West Africa. Records of port calls by ship to all the regions' ports were collated from the United Nations Conference on Trade and Development between 2018 and 2021. The records included port calls for six categories of cargo. These cargoes included the liquid bulk carrier (LBC), liquefied petroleum gas (LPG), dry bulk (DB), dry break-bulk (DBB), roll-on-roll-off (RORO), and container cargo (CC). The choice of 2018 as the base year was informed by the desire to observe the difference in patterns of calls by ship for all categories of cargo in all the regions from 2018 to 2019 before the COVID-19 disruption, between 2019 and 2020 which was the period of the pandemic and 2020 to 2021 a period witnessing the peak and the beginning of the subsidence of the effect of the pandemic. Exploratory methods were used to represent and explain the observed patterns of ship calls. Comparative analysis was also carried out for individual cargo types for all the years of study for all the regions. This was to ascertain regional performance in port calls for various cargo categories. Percentage change in port calls was also analyzed for all the categories of vessels between 2018/2019, 2019/2020, and 2020/2021 respectively.

Results

This section was divided into seven sections. Section "Aggregated port calls for all carriers" shows the result of the aggregated port calls for all the carriers between 2018 and 2021. Sections "LBC" to "Container" show disaggregated records of port calls for all the carriers between 2018 and 2021.

Aggregated port calls for all carriers

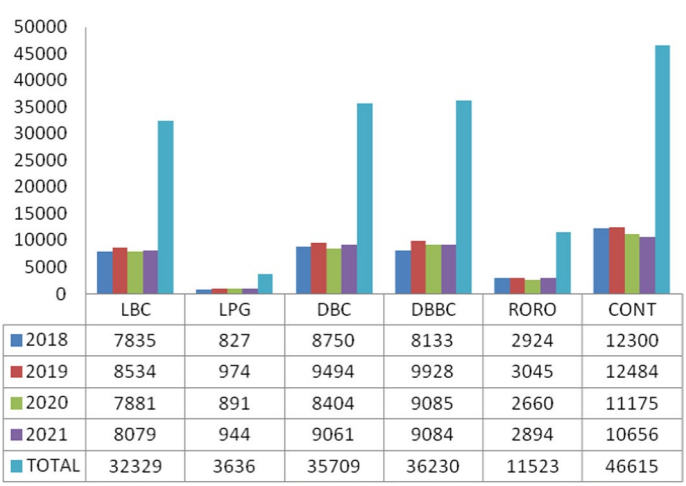
General results revealed that container carriers cumulatively had the highest port calls of 46,615 for the entire study in the entire region for the entire study period. This was followed by dry break bulk carriers with port calls of 36,230. Dry bulk and liquid bulk carriers had 35,709 and 32,329 calls while roll-on-roll-off and liquefied petroleum gas recorded 11,523 and 3636 calls respectively. However, disaggregated annual records showed that port calls were highest for all the carriers in 2019 with all the carriers witnessing declines in records of port calls in 2020. By 2021, roll-on-roll-off, dry bulk, liquefied petroleum gas, and liquefied bulk carriers were the only carriers that recorded recovery from the 2020 ditch in port calls (Fig. 1).

LBC

For port calls for LBC, the West African region has the highest records of vessel calls at ports throughout the study period. This was followed by Eastern Africa which recorded higher port calls for the period except in 2020 where the South African region surpassed it with a marginal difference of 15. Middle Africa recorded the least port calls for the entire period of study. However, in terms of year-on-year performance, comparative analysis revealed that East Africa has the highest annual increase in port calls between 2018 and 2019 followed by South Africa, West Africa, and then Middle Africa. Between 2019 and 2020, all the regions except Middle Africa recorded a negative percentage increase in port calls. For instance, East Africa recorded a − 10.71% increase, West Africa (-15.17%) while South Africa recorded a 5.89% port calls from its 12.7% increase between 2018 and 2019 (Fig. 2a and b).

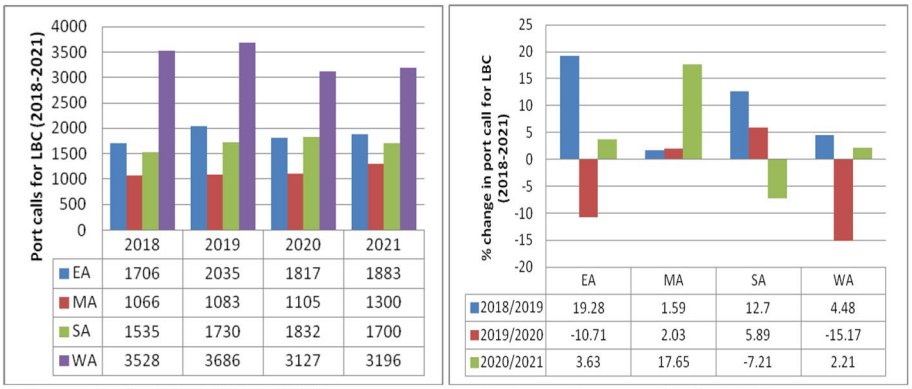
LPG

For liquefied petroleum gas, port calls, West Africa recorded progressively high port calls throughout the study period though the year-on-year percentage change revealed a marginal 0.44% between 2019 and 2020 when compared with the increase of 21.72% recorded between 2018 and 2019 and 12.06% post COVID-19 record between 2020 and 2021. Middle Africa has the second highest port calls throughout the study period



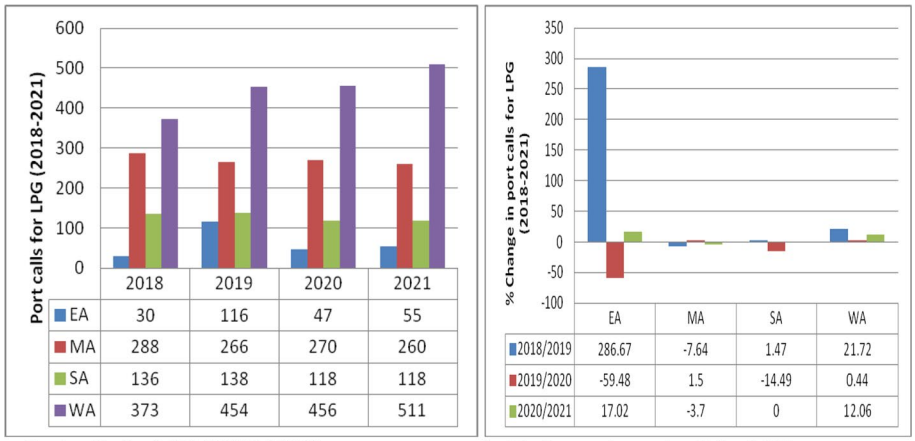
	LBC	LPG	DBC	DBBC	RORO	CONT
2018	7835	827	8750	8133	2924	12300
2019	8534	974	9494	9928	3045	12484
2020	7881	891	8404	9085	2660	11175
2021	8079	944	9061	9084	2894	10656
TOTAL	32329	3636	35709	36230	11523	46615

Fig. 1 Port calls for all carriers (2018–2021). *Source* Author's Analysis (2023) based on UNCTADstat



a: Port calls for LBC (2018-2021) b: % change in port calls for LBC

Fig. 2 **a** Port calls for LBC (2018–2021), **b** % change in port calls for LBC. *Source* Author's Analysis (2023) based on UNCTADstat



a: Port calls for LPG (2018-2021) b: % change in port call for LPG

Fig. 3 **a** Port calls for LPG (2018–2021), **b** % change in port call for LPG. *Source* Author's Analysis (2023) based on UNCTADstat

but with swinging records in and out of the study years. Percentage change reflected an increase of -7.46% between 2018 and 2019, a 1.5% increase between 2019 and 2020, and a negative increase of -3.7% between 2020 and 2021. Southern Africa which was the third in the order of ship calls for LPG recorded an increase of 1.47% from 136 to 138 between 2018 and 2019 only to record a dip of 14.49% from 138 to 118 between 2019 and 2020 and stagnated in the ensuing year. Though the East African sub-region recorded the lowest port calls for the study period, there was a striking upsurge of 286.67% between 2018 and 2019 where port calls moved from 30 to 118. This was later followed by a sharp decline of 59.48% between 2019 and 2020 and a little significant increase of 17.02% between 2020 and 2021 (Fig. 3a and b).

DBC

Southern Africa recorded a significant lead in port calls for dry bulk carriers in 2018, 2019, and 2020 but was surpassed by West Africa only in 2021. East Africa recorded

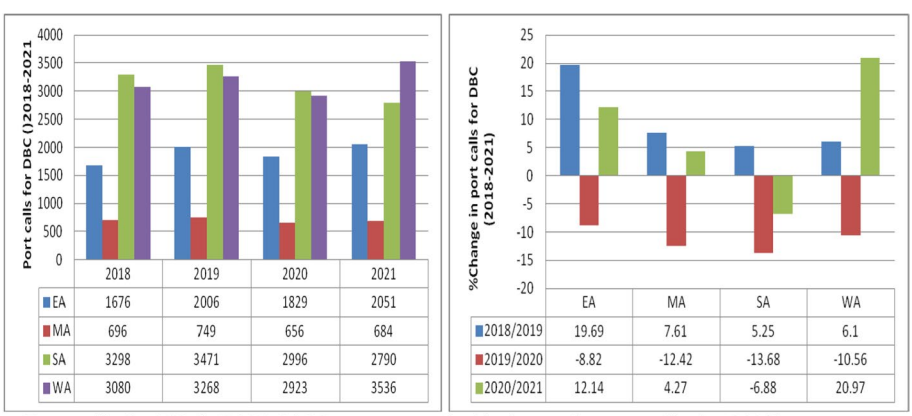
the third-highest but fluctuating port calls throughout the study period. However, the percentage change in port calls for all the regions showed East Africa with an increase of 19.69% between 2018 and 2019 followed by Middle Africa–7.61%, while South and West Africa recorded an increase of 5.25% and 6.1% respectively. Between 2019 and 2020, East Africa, Middle Africa, and South and West Africa all recorded negative percentage changes of − 8.82%, − 12.42%,—13.68%, and − 10.56%, respectively. However, all the regions except South Africa recorded a significant positive increase in port calls between 2020 and 2021 (Fig. 4a and b).

DBBC

West African region recorded the highest port calls for dry break-bulk carriers throughout the study period. This was followed by East Africa which also recorded swinging records tTransport and trade facilitationhroughout the period. Middle Africa recorded the third-highest port calls followed by South Africa. For all the regions, a positive increase was recorded between 2018 and 2019 with West Africa having a very significant increase of 48.39% from 3441 in 2018 to 5106 in 2019. This was followed by East Africa with a 5.92% increase in port calls. Whereas, Middle Africa and South Africa recorded very marginal increases of 0.85% and 0.29%, respectively between 2018 and 2019. Between 2019 and 2020, all the regions recorded a negative percentage change in port calls for dry break-bulk cargo, with the South African region recording the highest negative percentage change of 22.36% in the year. However, between 2020 and 2021, there was a drastic improvement in port calls for East Africa, and South Africa from what was the case between 2019 and 2020 while Middle and West African regions recorded a negative percentage change during this period (Fig. 5a and b).

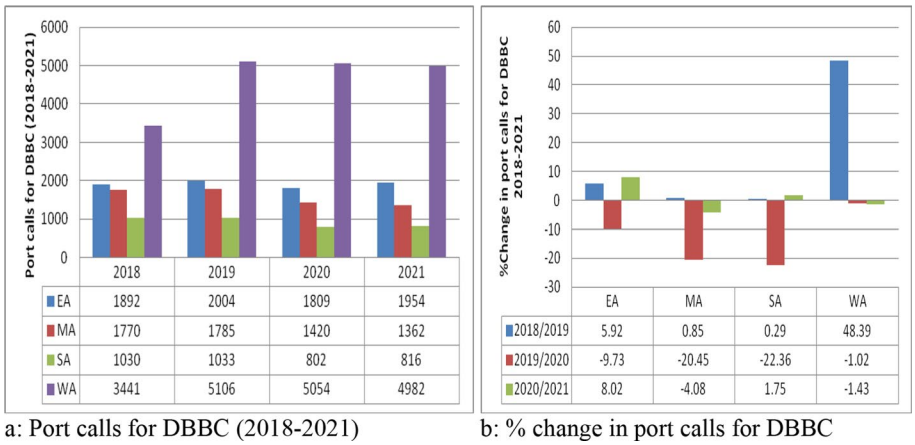
RORO

Records of port calls for Roll-on-Roll-off showed the West African region leading throughout the study period though with highs and lows swing. This region was followed by East Africa while South and Middle Africa recorded third and fourth high records respectively. However, the annual percentage change revealed that East



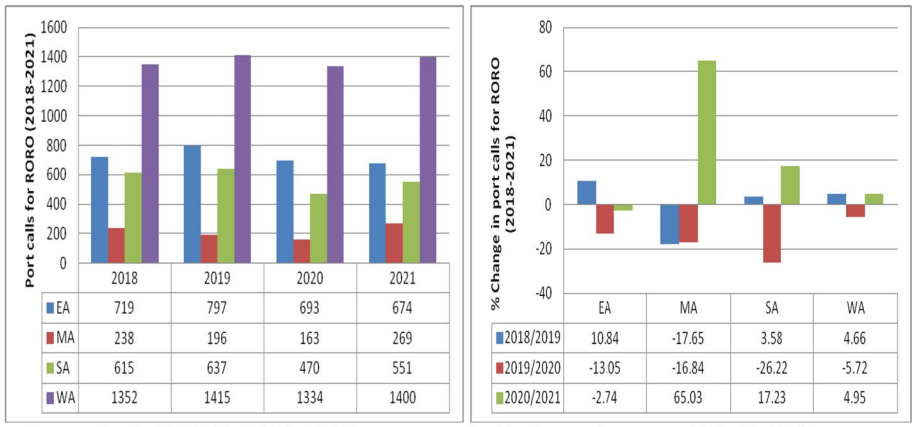
a: Port calls for DBC (2018-2021) b: % change in port calls for DBC

Fig. 4 **a** Port calls for DBC (2018–2021), **b** % change in port calls for DBC. *Source* Author's Analysis (2023) based on UNCTADstat



a: Port calls for DBBC (2018-2021) b: % change in port calls for DBBC

Fig. 5 **a** Port calls for DBBC (2018–2021), **b** % change in port calls for DBBC. *Source* Author's Analysis (2023) based on UNCTADstat



a: Port calls for RORO (2018-2021) b: % change in port call for RORO

Fig. 6 **a** Port calls for RORO (2018–2021), **b** % change in port call for RORO. *Source* Author's Analysis (2023) based on UNCTADstat

Africa has the highest percentage increase in port calls of 10.85% between 2018 and 2019. This was followed by West Africa with a 4.66% increase in port calls. South Africa has a 3.58% increase while Middle Africa recorded a decrease of 17.65% between 2018 and 2019. Percentage change between 2019 and 2020 showed that all the regions recorded negative changes in port calls. Specifically, the West African region had the highest negative change of − 26.22% followed by Middle Africa with a change of − 16.84% while East and West African regions recorded − 13.05% and − 2.72% change respectively. However, between 2020 and 2021, Middle Africa recorded a drastic recovery of 65.03% increase from what was recorded in 2020 followed by South Africa (17.23%) and West Africa (4.95%) while East Africa still recorded − 2.74% change between 2020 and 2021 (Fig. 6a and b).

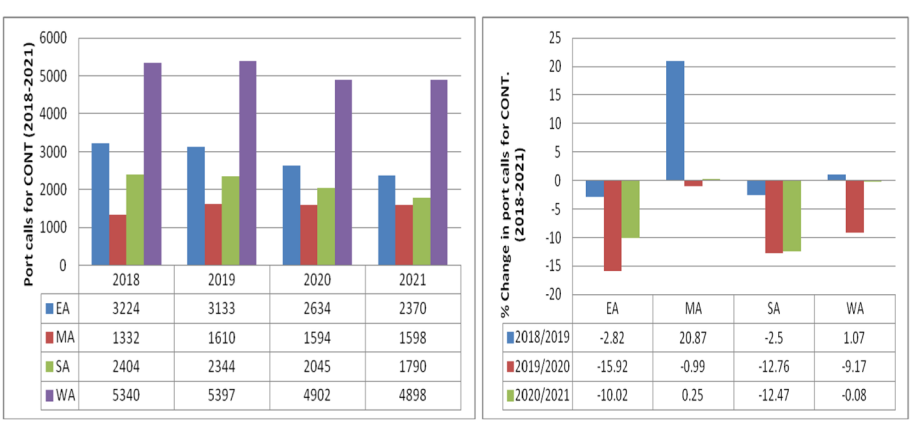
Container

Records of port calls for container cargo showed that the West African region has the highest but swinging port calls for the entire study period. This region was followed by East Africa and South Africa and Middle Africa in that order. However, the percentage change in port calls between 2018 and 2019 showed that Middle Africa has the highest positive percentage change of 20.87% followed by West Africa which has 1.07%. South Africa and East Africa recorded negative percentage changes of − 2.5% and − 2.82% respectively. Between 2019 and 2020, like the case of other freight types, port calls for container freight returned negative percentage changes for all the regions with East Africa having the highest negative change of -15.92% followed by South Africa which has − 12.76%. West and Middle Africa recorded -9.17% and -0.99% respectively. However, in 2021, the percentage change recorded from port calls in 2020 showed that only Middle Africa has a positive record of change of 0.25% while other regions recorded negative changes (Fig. 7a and b).

Discussion

The results of the analysis of port calls for all the regions in sub-Saharan Africa reflect similar global experiences for all vessel calls. Though the impact of COVID-19 on maritime port calls by various vessels varies significantly by region, it was evident that all the regions across the globe experienced a contraction in number of port calls by vessels. For instance, globally, port calls for LBC fell by 4.9% between 2019 and 2020, LPG, − 3.1%, DBC-4.1%, DBBC-7.8%, and RORO and Container, by 12.8% and 2.8% respectively (UNCTAD 2022a, b). This experience was also similar to port calls even by many major ports in other regions with strong gateway functions. And at the same time confirming UNCTAD's (2020) estimated declines in the maritime industry in 2020.

Generally, the contraction in the number of port calls for all categories of vessels selected was unarguably the result of the inevitable closure of industries brought about by the ripple effect of COVID-19 on global demand for raw materials and finished goods. Port calls by all regions, especially between 2019 and 2020 which was the period of emergence, diffusion, and maturity of the pandemic revealed the vulnerability of



a: Port calls for RORO (2018-2021) b: % change in port call for RORO

Fig. 7 **a** Port calls for RORO (2018–2021), **b** % change in port call for RORO. *Source* Author's Analysis (2023) based on UNCTADstat

transport networks especially seaports to shocks. This thus highlights claims in the literature of the difficulties of carriers to adapt to network disruptions and market shocks (Chen et al. 2016; Achurra-Gonzalez et al. 2019). This was emphasized by Xu and Itoh's (2018) explanation of the effect of Hanshin's earthquake of the mid-1990s on the Japanese ports. A similar explanation was given by Rousset and Ducuret (2020) in their combined studies of the effect of the Hanshin earthquake, the 9/11 World Trading Centre attack, and Hurricane Katrina on maritime routes and trade. According to Rousset and Ducuret (2020), although the three events may differ in their nature, intensity, scope, and location of occurrence, they all triggered a shock in maritime traffic and disrupted the usual operation of some key ports in the global maritime network.

However, UNCTAD (2020) had already predicted the world maritime trade recovery by 4.3 percent in 2021 and also projected growth in maritime trade to continue over the 2022–2026 period. At the global level, recovery was more robust in dry bulk carriers, dry breakbulk carriers, and liquid bulk carriers. For dry bulk carriers, there was a 6.6% increase. For container ships, however, the increase was only 1.1%, due to global container shortages and heavy port congestion (UNCTAD 2022a; b).

The records of delay in port call recovery in 2021 may thus be attributed to the nature of the exports of the region which are largely raw material and unprocessed commodities. The slow pick by the region after covid-19 may also be attributed to the fact that African countries are generally not well-integrated into global manufacturing and trading networks, (Konstantinus et al. 2019). Another reason may be due to a drop in the region's importation caused by reduced demand, exchange rate movements, and shortage of foreign currency which may result in a fall in schedule reliability which led shipping companies to withdraw their shipping capacity in favour of routes that could guarantee more profitability. This was the case because shipping companies which have lost so much in profits due to high charges from demurrage and detention sought out ports where the cost of doing business was less biting. However, recovery in port calls by most of the vessel types in all the regions in 2021 attested to Clarksons Research's (2021) suggestion that global seaborne trade will surpass 2019 levels by 0.5% to reach 12 billion tonnes in 2021.

Conclusion

The emergence and diffusion of COVID-19 exhibited an unprecedented negative impact on maritime trade in sub-Saharan Africa, reducing the number of port calls at subregions within sub-Saharan Africa. The study, through the result of the data available, revealed a huge decline in port calls for selected vessel types. This thus emphasized the delectable significance of seaports and port calls in the global and regional distribution and redistribution of materials and finished goods thereby bringing home the need for greater preparedness and resilience against any external threats. Thus, to maintain productivity, keeping ports open remains one of the major strategies for maintaining if not increasing vessel calls during disruption, thus requiring various governments in sub-Saharan Africa to devise measures or action plans that ensure business continuity during a pandemic scenario. Such plans may include the deployment of requisite technology including but not limited to communication tools to handle all port-related activities to ensure uninterrupted port services on all scales. The adoption of technological solutions

and digitalized processes at ports may assume an important element for building resilience to future disruption of maritime transport in supply chains. This gesture, among other things, will form part of the strategies for economic recovery for the region during any potential pandemic scenario.

The limitation of this study is that disaggregated data for ports of individual countries in the regions were not used to ascertain the port-and-country-level impact of COVID-19. Thus, a future study can be expanded to cover every port within all the selected regions in sub-Saharan Africa to estimate the peculiarities of responses of individual ports and countries to potential pandemics.

Abbreviations

COVID	Coronavirus disease
SSA	Sub Saharan Africa
UNCTAD	United nations conference on trade and development
LBC	Liquid bulk carrier
LPG	Liquified petroleum gas
DBC	Dry bulk carrier
DBBC	Dry break bulk carrier
RORO	Roll-on-roll-off
CC	Container carrier

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Author contributions
OM wrote the entire manuscript from conceptualization through to conclusion of the study.

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Availability of data and materials
The data that support the findings of this study are available from United Nations Conference on Trade and Development Statistics Beyond 20/20 WDS—Table view—Port call and performance statistics: number of port calls, annual (unctad.org) and Beyond 20/20 WDS—Table view—World seaborne trade by types of cargo and by group of economies, annual (unctad.org).

Declarations

Competing interests
There is no known conflicting interest with any person or agency in respect of the writing and submission of this article.

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