Towards a sustainable China-Africa forest trade; an assessment of environmental implications for FOCAC members

Abstract: Resource for aid or otherwise Characteristics most of Africa trade relationships. However with an increasing global climate change warnings, the need to understand the trade-off from forest trade in relations to CO2 emissions is paramount in shaping forest product trade and sustainability at the long run. This study therefore tests the haven and halo hypothesis based on the FMOL technique by analyzing China-FOCAC forest products trade engagements. A balanced panel data of 20 FOCAC members was selected based on availability and consistency from 2000-2014. The variables; forest products trade (exports value), GDP per capita, FDI inflow, institutional quality, energy use and carbon emissions were gleaned from world bank and united nations database. The descriptive statistics results reveals a disparity in economic growth, FDI inflow and value of forest products exports among FOCAC members. Per the FMOL estimation results, China-FOCAC forest products trade have insignificant impact on the level of carbon emissions in the selected countries which contributes to the ongoing debate on whether Africa is a pollution haven for China. Nevertheless, Per capita GDP and energy use are significant drivers of emissions whereas FDI's and the quality of institutions shown high potential of transforming the quality of the environment in the selected countries. These results are paramount in shaping existing and future forest trade agreements.

Keywords: FOCAC; Forest products, carbon emission, FDI, China-Africa

1. Introduction

China has become the largest importer of logs, pulp, and sawn wood and the largest exporter of wood furniture and wood-based panels. Forest industries (panel, furniture, pulp, and paper industry) are sectors with high energy consumption and high carbon emissions in terms of per unit GDP contribution. [1]. The global environmental institute estimated that 75% of Africa's timber is exported to China [2]. Today with the intensification of global forest trade as a result of increased usage, the demand for specialized wood-based products and fiscal economic pressure on most less endowed forest resource economies necessitate the continuity of forest removal despite potential environmental hazards. Additionally, due to the rising levels of pollutants that accompany international trade, there have been numerous concerns about potential environmental consequences on particularly economies with feeble infrastructures to handle the impacts. Although one of the core motives of Forum on China Africa Coperation (FOCAC) is to foster low-carbon development and climate change adaptation in Africa whilst increasing the volume of imports.[3],there has been an intertwining conception in literature as to whether China is a pollution Halo or a haven for trade[4], [5]. Similarly persistent inflow of foreign direct investment (FDI), weak environmental regulations and fragile institutions, and high level of exports have rendered most FOCAC countries pollution havens for the developed regions of the world due to poor. Moreover, evidence of the EKC hypothesis assumes that the revenues derived from such trade revenues can gradually help transform and avert the environmental risk that accompanies the trade-off in the long run. This study, therefore, employs the Pollution haven[6], pollution halo hypothesis[7], and the Environmental Kuznets curve [8] as the theoretical basis to test the relationship between forest product exports and CO_2 emission with particular emphasis on China and representative countries of the Forum on China and Africa cooperation (FOCAC). Several studies[9]–[11] have explored the relationship between different trade variables and CO_2 emissions, nevertheless literature on forest trade and carbon emissions are still limited.

Again after 20years of FOCAC's existence, its objectives in relation to trade and climate change are yet to be analyzed as proposed in this study. Moreover, evidence of the environmental Kuznets curve in forest product trade, economic development, and energy consumption and its contribution toward emission in FOCAC countries is lacking.

The structure of the study is as follows: Section 2 focuses on reviews from related studies about forest trade, pollutions haven, and the halo hypothesis and also presents the innovation of the study, Section 3 explains the materials, econometric approach, and data sources, Section 4 elaborates the main results and discussions, whiles Section 5 summarizes the main findings and limitations of the study to draw possible recommendations based on the identified gaps.

1.1 Literature and hypothesis Development

Both previous and current literature focusing on trade and CO_2 emmisions has focused on testing three main hypotheses; the Pollution haven[6] and pollution halo[7] as the theoretical basis as a result we analyse the findings,contrasting results, arguments and recommendations as a basis for this current study.

1.1.1 Pollution haven (trade and CO_2 emissions)

A pollution haven refers to governments using low environmental standards to induce firms to invest, thus creating a haven for polluters [1] The pollution haven hypothesis emphasizes that international trade could increase global pollutants emissions[12]. Although Forests and the forest products industry contribute to climate change mitigation by sequestering carbon from the atmosphere and storing it in biomass[1], nevertheless continuous forest removal fueled by increased forest products trade will pave way for countries with high levels of pollution, such as China and Russia to export their pollutants to poor resourced states with lax environmental standards [4], [13].In terms of global trade and environmental risks, existing literature continues to focus on "where are the pollution havens?" as posed by[7] in testing pollution haven theory among different economic and partner groups. For instance, evidence of haven has been found in Belt and Road countries[4], BRICS states [14], country groups [15], and even global [13] therefore in the context of China-FOCAC forest products trade, it is meaningful to explore this relationship as a contribution to forest trade and environmental policy literature hence based on the above literature we propose that;

The volume of Forest products exports from FOCAC members to China increases CO_2 emission

1.1.2 Pollution halo (trade and CO_2 emissions)

According to the halo theory of pollution, international investment and trade may drive the transfer of clean technologies and best economic and management practices from developed to low-income economies. This means partners with free trade agreements may even drive more environmental benefits through the exchange of low pollution innovations [16]. Subject to the above hypothesis recent studies [11] have tested the impact of different trade routes on the environment based on the direction of FDI and general exports. Singhania & Saini, (2021) also showed evidence of the relationship between institutions, FDI, income, and the level of pollution. Similarly [9], [11], revealed that, regardless of the resources available in a nation, FDI is more likely to influence the level of environmental degradation. However, China has not been only labelled as a high polluter but also a frontrunner in the transfer of renewable energy initiatives, smart technologies hence its engagement with weak economies such as the FOCAC group can yield environmental merits or demerits. From the aforementioned findings, it is, therefore, logical to consider the foreign direct investment and exports in testing the Halo hypothesis for the selected focus group since the FOCAC agreement fosters trade, environmental sustainability and provides opportunities through direct investment toward the forestry industry and national development of most trade partners. Hence, we hypothesise that;

The volume of forest products exports from FOCAC states to china and china's foreign direct investments reduces carbon emissions

Chart 1: Summary of current studies on trade and CO_2 relationship

Author and region of focus	Relationships studied	ECONOMETRIC model	Key findings
[11] China and 50 African states(1992 to 2014)	Total import,export, energy consumption,FDI, constrution projects,GDP, population,GDP growth and CO2	Fully Modified Ordinary Least Square (FMOLS)	Export and FDI reduces carbon emissions whilst imports detoriorates the environment.
[9] 44 subsaharan African Countries (From 2000-2012)	Trade,FDIpopulation growth, education quality, regulation quality and GDPgrowth and CO2	Generalised method of moments(GMM)	enhancing trade reduces CO2 emissions whilst increasing FDI increases CO2 emissions.
[18] 15 Mediterranean countries form Europe,Africa and Asia (1990 to 2013)	growth, FDI inflows, CO2 emissions, and human capital,energy counsumption,trade openness,domestic capital,population and CO2	FMOLS and DOLS Granger causality	bidirectional causality is confirm between economic growth, FDI inflows, CO2 emissions, and human capital for African States wheras the following unidirectional causality is found in Europe and Asian states; GDP to FDI, GDP to human capital,FDI to human capital, andhuman capital to CO2 emissions.
[19] Emerging markets (E11 economies) 2005-2014	FDI,GDP,trade openness,population and CO2	panel smooth transition regression (PSTR) model	Both pollution heven and halo are confirmed indication a direct positive effect of FDI and a negative spill effect of FDI and CO2 respectively.
[20] 14 ECOWAS States and the world (1970 and 2014)	CO2 and per capita GDP regional trade, global trade	PMG/MG method of panel ARDL	effect of trade on the quality of the environment is evident at the long run. The effect of Global trade is more than regional level trade

[21]High, low and middle income Mediterranean countires(1980-2014)	Trade openess,Real GDP,export,imports and CO2	FMOLS	Trade openness impedes environmental quality for the global, high income, middle and low income panels but the impact varies in these diverse groups of countries.
[4] China and 64 countries along the Belt and Road	GDP,trade volume,and percapital carbon emission from 26 sectors of the economies	Multi-regional input-output analysis Multi-regional (haven hypothesis validated model)	The pollution heaven hypothesis is confirmed in 19developing and 24 developed countries respectively
[22] 43 sub-saharan African countries 1990 to 2011	Institutional quality,forest size,population,energy intensity and CO2	generalized method of moments (GMM)	Regardless of the level of energy intensity,the quality of institution enhance the quality of the environment.Moreover,the level of carbon emission decreases with incresing forest cover
[23] Global Agricultural and forest trade (2010–2014)	Agricultural and forest commodities trade flows	physical trade (PT) model multi-regional input output model (MRIO)	Deforestation and carbon emissions in Africa is mainly driven by exports. Europe and China accounts for most imports, nevertheless emissions embodied in imports surpass emissions from local agriculture in developed countries.
[24] 65 belt and road initiative countries	Energy consumption,urbanization, FDI, population,export,import and CO2	. 2SLS (2-stages least square) regression	Although the Environmental Kuznets Curve hypothesis is confirmed for uppermiddle and high income members,CO2 emissions is found to increses with FDI,wheras exports decreased carbon emissions in low and high income countries,

***Source:**authors compilation*

1.2 Literature Gap

Previous literature focused on the relationship between either FDI or trade and the environment, others have also incorporated the effect of diverse possible international trade routes on the environment.However this study narrows specifically to forest product trade and the environment,an area of study which demands much attention based on the redflags raised in the 2020 forest resource assessment report[25] and the direct role of the forest in shaping global CO2 emmissions[1].moreover , this present study overriddes the existing studies by focusing on the nexus between forest product trade between a solitary country (China) and groups of countries (FOCAC group) instead of the traditional FDI multiple-individual country analysis.additionally,we the study uniqulely tests most consistent and efficient environmental hypothesis (halo and haven) for the first time on the selected focus group for the past 20 years since the initiation of the FOCAC agreement.more specifically through the dynamic FMOL test on variables of interests(institutional guality,engergy use,FDI and volume of exports are acertained to understand their corresponding influence on the environment. Finally By focusing one of the most controversial trade forum and the most sensitivy natural resource linked to carbon emissions, this study provide a comprehensive valid reference for forestry economics and environmental literature and also serves as a guide for policymakers and scholars in understanding and proposing environmental policies that ensure balanced gains in global forest trade and investments.

2. **Material and Methods**

2.1 Data Collection

The study uses panel data of 20 FOCAC countries from 5 African states(West,East,North,southern and Central Africa) comprising of Benin,Cameroon,Congo,Dem. Rep. of the Congo,Cote d'Ivoire,Gabon, Ghana,Kenya ,Mozambique, Nigeria, SouthAfrica, Togo ,Tunisia,Tanzania,Zambia,Mauritius,Angola,Egypt,Morocco,Senegal from 2000 to 2014. Data on China-Africa investment flow (FDI) were gleaned from China Africa Research Initiative (2020) at Johns Hopkins University,wheras forest product trade data(Import and exports) was obtained from the FAO.The ramianing variables of interest including CO_2 emission, energy consumption as kg of oil equivalent, GDP per capita, GDP growth, and total population, were accessed from World Development Indicators (2020) of the World Bank.

2.2 Model Estimation

FMOLS was proposed by [26] as a residual test that eliminates the problem of endogeneity in panel data. Furthermore, FMOLS can also work with a small size sample and take care of serial correlation [24], [27].

To overcome the limitation posed by the fixed effects model, we use the Fully Modified Ordinary Least Square (FMOLS) approach to examine the impact of the different routes of China's international business in Africa on the environment. We chose the FMOLS approach over other econometric approaches because it produces reliable estimates for small sample sizes. Also, the FMOLS mitigate endogeneity, heteroscedasticity, and correlation problems in the data [11].

Lastly, the FMOLS model estimates the long-run relationship between the selected series. Due to its superiority, FMOLS is widely used in recent literature [18] on international business and environment nexus. However because we are interested in the impact of forest export between China and the selected FOCAC countries on the environment, we specify a panel equation and account for possible drivers of emissions as follows.

$$CO2_{it} = f(exporti_{it,} GDP_{it,} energyuse_{it,} FDIit_{,it,} InstQ_{it})......................(1)$$

Where carbon emission is C02, energy consumption per capita is denoted by energy use, FDI represents the inflow of foreign direct investment from China to selected African countries whereas the level of institutional quality (effective governance) is represented as instQ and the time is accounted for by (it).

$$InCo2_{it} = \beta_0 + \beta_1 export_{it} + \beta_2 InGDP_{it} + \beta_3 energyuse_{it} + \beta_4 FDI_{it} + \beta_5 InInstQ_{it} + \mu_{it}......................(2)$$

To ensure that variables deliver direct elasticities for easier interpretation of results, equation 2 presents variables in their natural logarithm form. Where β measures the estimated coefficients of all the variables (exports, GDP, energy use, FDI, Export, and InstQ), μ represents the error term and each country's fixed effects (countries and period) are denoted by the subscripts it.

2.3 Data Analysis

Eviews version 10 and Microsoft Excel version 2019 were employed for sorting and analyzing the secondary data. Before estimating the variables, the is a need for Levin and the IPS test as a measure of series stationarity based on the null hypothesis of no stationarity among series and otherwise for the alternate hypothesis[28] Next is the performance of the predroni test [26]to analyze the presence of co-integration among the series based on the null hypothesis of no co-integration and the alternative hypothesis of co-integration.

3. Results and Discussion

We present the descriptive statistics of the variables in **Table 1.** The average CO_2 is 0.0163, which is far less than that of China's CO_2 of 10 billion tons in 2018, the United States(5.4 billion tons) and the European Union states (3.5 billion tons),[29]. Among the possible drivers of carbon emissions, FDI is the lowest, and the value of forest product exports is the highest (350537.0). This supports the evidence that about 75% of Africa's forest products make their way to the Chinese market [30]. Moreover, FDI inflow from China reached a maximum of $3757.727 which is significant to cause an economic impact on the selected countries. additionally, given the economic transitional stage of the selected countries, the level of GDP and level of energy use gives evidence of the rate of industrialization between 2000-2014. Finaly , the high standard deviation shows that there is variation among the sample countries with regards to the economic variables.

Table 1 . Descriptive Statistics

Variable	Description	Mean	Sd	Min	Max	Obs	Source
CO_2	Carbon dioxide emissions (kg)	1.274899	1.768507	0.016313	8.568994	300	World bank
GDP	GDP per capita (constant US dollar)	2228.739	2330.891	153.5910	10809.68	300	World bank
Energy use	Energy Consumption (kg of oil equivalent)	6.326709	0.609927	5.424876	8.048490	300	World bank
FDI	China-AFRICA Foreign direct investment inflow (constant US dollar)	183.3140	494.2301	0.000000	3757.727	300	John Hopkins institute
Export	Total Forest product exports (constant US dollar)	32287.25	65472.68	0.000000	350537.0	300	FAO
INSTQ		35.06202	20.70151	0.000000	86.77248	300	world bank

Panel Unit Root Test

To verify the stationary of panel data, this study employed Augmented Dickey-Fuller (ADF) and Fisher Phillips Perron (PP) tests. As the results may be spurious if the data is non-stationary. Fisher ADF and Fisher PP tests do not require strictly balanced panels nor require the same lags in individual ADF regression.

Moreover, both tests confirm the presence of panel unit root [18], [24], [31]. Except for Institutional quality which showed significance at both level and first difference, all the variables CO2, GDP, export, FDI, energy use, exports are stationary at first difference as represented in **table 2**.

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Table 2 ADF and Fisher PP results

variable	Level	Fisher ADF statistics	probability	PP - Fisher Chi-square	probability
CO2		46.7425	0.2151	60.9447***	0.0180
GDP		37.8260	0.5685	48.8719	0.1586
export		51.3117	0.1084	64.6632***	0.0081
FDI		37.0701	0.2465	44.1262	0.0751
instq		61.1594	0.0172***	88.0580***	0.0000
Energy use		24.2389	0.9767	33.4363	0.7589
	First difference	**Fisher ADF statistics**		**PP - Fisher Chi-square**	
CO2		160.989***	0.0000	180.943***	0.0000
Gdp		152.224***	0.0000	154.689***	0.0000
export		151.160***	0.0000	194.980***	0.0000
FDI		78.5787***	0.0000	111.128***	0.0000
Instq		158.700***	0.0000	188.714***	0.0000
Energy use		147.475***	0.0000	169.619***	0.0000

After establishing the stationarity of the data, we use the [26], [32] approach to determine whether a co-integrating relationship exists among the series. The approach employs four-panel statistics and three-group panel statistics to test the null hypothesis of no co-integration against the alternative hypothesis of co-integration. In the case of panel statistics, the first-order autoregressive term is assumed to be the same in all the cross-sections. In contrast, in the case of group panel statistics, the parameter is allowed to vary over the cross-sections. If the null is rejected in the panel statistics, then the variables of the carbon dioxide emission function are co-integrated for all the sectors. On the other hand, if the null is rejected in the group panel case, then co-integration among the relevant variables exists for at least one of the sectors. The results of the panel co-integration test is displayed in **table 3.** The result of within-dimension shows that out of the four cases, two cases are significant, leading to the rejection of the null hypothesis of no co-integration among the variables. The result of between-dimension shows two out of three instances are significant, suggesting a rejection of the null hypothesis of no co-integration. Hence, CO_2, FDI, Export, Energy use, GDP per capita, and instiQ, are co-integrated in this panel.

Table 3. Pedroni panel co-integration test results.

Model	Statistic	Prob.
Panel v-Statistic	-0.871973	0.8084
Panel rho-Statistic	2.137223	0.9837
Panel PP-Statistic	-4.659103	0.0000
Panel ADF-Statistic	-4.724662	0.0000

Group rho-Statistic	5.432377	1.0000
Group PP-Statistic	-5.241340	0.0000
Group ADF-Statistic	-2.692920	0.0035

(a) Carbon emission and forest product exports(FOCAC-China)

Despite the significant role the forest plays in the overall balance of carbon in the atmosphere, there have been contrasting views on the contribution of Forest towards carbon emission levels in recent years. Whilst others [25], [33] identify forests as the net source of carbon, some [15], [34], [35] view it from the carbon sink perspective. With regards to co_2 emissions embodied in forest trade,[23] that around 10-40% of emissions are driven by international trade.

Table 4. Results of Panel Fully Modified Least Squares (FMOLS) Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXPORT	2.79	2.87	0.97	0.33
ENERGY_USE	0.08	0.15	5.34	0.00[a]
FDI	-3.83	1.54	-2.48	0.01[a]
GDP	0.16	1.64	9.88	0.00[a]
INSTQ	-0.29	0.08	-3.47	0.00[a]
Adjusted R-squared	**0.99**			

Note: a denotes a 1% significance level.

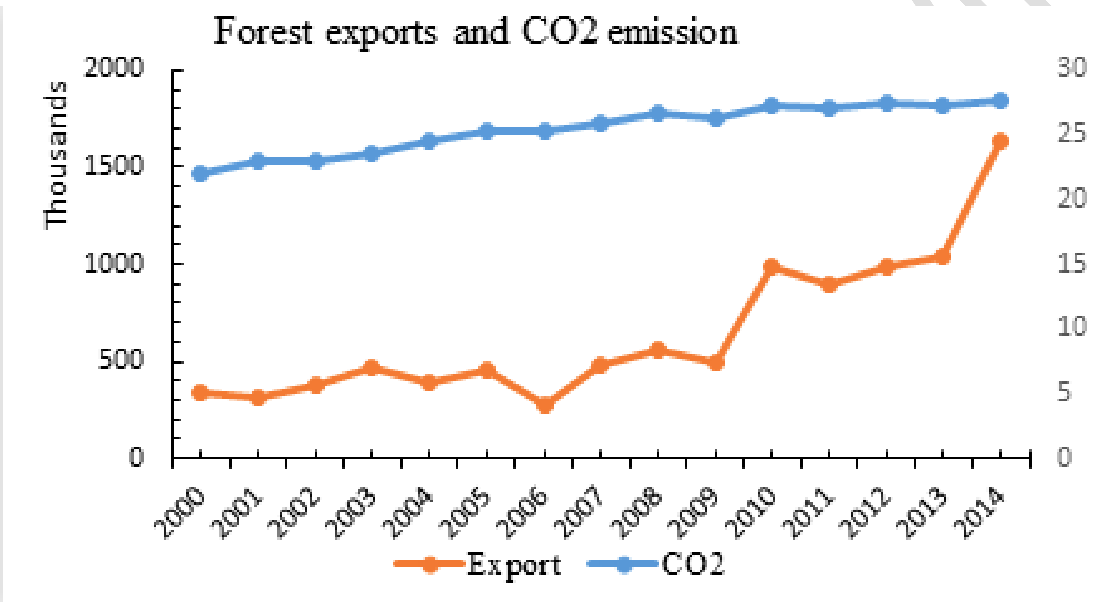

Figure 1. Forest export and carbon emissions

Nevertheless, from **table 4**, there is no evidence (0.33) of the relationship between forest product exports from the selected 20 FOCAC states. Though the value of exports to China has improved significantly from 2000 to 2014, the levels of emissions remained constant for most of the years as elaborated in **fig 1**. There might be several reasons accounting for the above results as purported in literature. First, the volume of forest products exports from these countries to China is below 0.1% share of the global forest trade as compared to exports from larger trade partners (Brazil, Russia, and Canada). Additionally, looking at the complexity of forest products, carbon stock, and the types of forest products mainly unprocessed logs it can be argued that carbon transfer is evident in this direction of trade as revealed by [36] in the case of developing and developing countries.

Moreover stronger institutions that give rise to efficient sustainability policies might influence the expected outcome. [37] also asserted they might be complexities since harvested wood products retain certain amounts of carbon which are later realized at their final destination as there are altered into different products. For these assertions, the results obtained contribute to the literature on the complexity of the contribution of forest products to levels of emission.

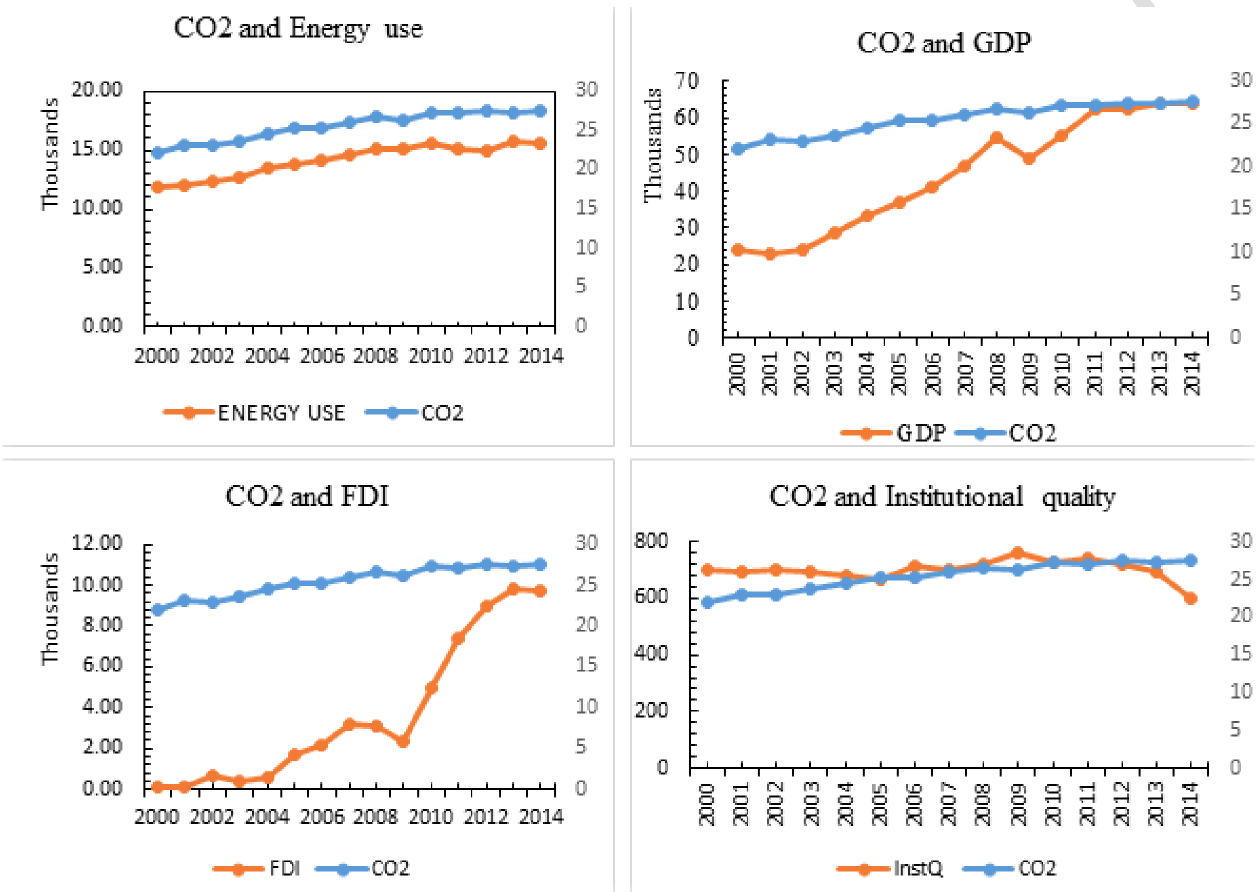

Figure 2: FDI, institutional quality, energy use, GDP and carbon emission nexus

Though the study's envisaged the relationship between forest trade and carbon emissions, an understanding of other possible drivers of CO_2 is paramount in understanding and formulating future multi-institutional low carbon policies. Again since the FOCAC agreement on environmental sustainability does not only focus on the forest trade, we found it more practical to explore other mediating variables reported in the literature.

(b) Carbon emissions and energy use of FOCAC Countries

In recent studies, the relationship between the consumption of energy and the level of carbon emissions has been reported as positive regardless of the level of income of countries [24]. Furthermore,Sun et al. (2019) found a similar positive relationship for Asia, Europe, the middle east, and African countries between (1991–2014). The current findings also correspond to the aforementioned pieces of evidence at a significant level of (0.00) as shown **in table 4**. An increase in the level of energy consumption of FOCAC countries is associated with a 0.08% increase in carbon emissions.

Since global trade is anticipated to grow at 10% annually this level of consumption is also likely to increase as different forms of forest products such as paper are intensified as part of the industrialization agenda of the selected countries. **Figure 2** clarifies the 14year (2000-2014) corresponding growth between CO2 and energy consumption.

(c) CO2 and income level (GDP) of FOCAC Countries

The direct role of income in formulating green policies aimed at curbing the rising levels of atmospheric carbon continues to dominate environmental literature since the formulation of the environmental Kuznets curve hypothesis [9], [39]. In analyzing CO2 and income nexus [39] found evidence of both short and long-run positive associations in correspondence to the environmental Kuznets curve hypothesis. Other studies in sub-Saharan Africa [11], [15], [20], oil-producing countries [40], European Union [39], [41], and developed states [4] have revealed similar findings. From **fig 2** and **table 4**, the results confirm a positive relationship between income and carbon emission at a 0.00 significant level. Although the emission growth rate has been slow as compared to GDP, the level of growth from 2011 to 2014 is corresponding. The coefficient further confirms that income growth can cause result in about 0.16% rise in the level of emissions.

(d) CO2 and Foreign direct investment(FDI) flow from China to FOCAC Countries

Emerging economies continuously rely on FDI as an effective source for economic growth and developmental projects. However, the consequences associated with high levels of FDI inflows could be diverse economic catastrophes such as that of Montenegro and Zambia which are currently at an unprecedented level of indebtedness due to high FDI inflow [42], [43]. In the case of FDI- carbon nexus, there have been contrasting views in literature hinged on the pollution haven hypothesis which asserts that FDI flow can potentially induce the transfer of pollution from developed regions to FDI recipient countries[6], [19].on other hand [7] proposed the halo hypothesis focusing on the possible reduction of emissions due to the influx of pollution reduction technologies embedded in FDIs.The latter is evident in this present study as revealed in the FMOL estimation results (table 4).

Similar to the outcome [11], [18], [19], [44], [45] we found that a unit increase in FDI inflows from China to FOCAC countries will lead to a decrease (-3.83%) in the atmospheric carbon emissions. This does not only reveal the environmental gains from the FOCAC agreement since inception but also unravels the nature of

FDI's inflows. Though FDI towards the environment is of the least, sectors such as transport and power (energy) have received adequate support in terms of cleaner technologies transfer which could help curb the high levels of transportation and energy production. The forest sector is also expected to drive similar environmental benefits through efficient initiatives such as the China-Africa forest governance[30].

(e) CO2 and institutional quality of FOCAC Countries

[46] revealed that policymakers need to pay attention to developing local institutions as an effective measure in curbing the rising environmental degradation. This present study also affirms the aforementioned recommendation based on the significant results obtained (0.00). See **table 4** and **fig 2**. With effective political stability in FOCAC countries, the rate of emission could be reduced (-0.29) since agencies such as environmental protection, financial institution, and the forestry sector are interconnected and function effectively in a politically stable environment. In the case of Africa, [22] concluded that nations with healthier institutions exhibit greater prospects than countries with weaker institutions. Furthermore, [47] asserts that in the case of China, the lack of institutional reforms has altered embodied carbon emission. Although CO2 emission poses a high climate risk, strengthening environmental institutions proves efficient in averting such potential impacts [48]. [49] argued that in the case of developing countries such as Malaysia where economic growth is fast taking shape, efficient institutional frameworks and policies provide fertile grounds for green economic growth whilst averting environmental risk. In the case of the FOCAC initiative which offers the possibility of sustainable trade cooperation, it is anticipated that both countries will strengthen institutional collaborations based on their relevance in shaping the global environmental impact.

Conclusion

The present study aimed at investigating Carbon emission and forest product trade (export) nexus in the context of Forum for China Africa cooperation. In doing so we cleaned 14-year data (200-2014) from 20 FOCAC members based on consistency and data availability.

Based on the FMOL estimation technique we test Halo and haven hypothesis using the variables value of exports, GDP, energy use, institutional quality, and FDI. As discussed above the findings from this study leads to the following conclusion;

a) Evidence of the Halo hypothesis in the context is affirmed. The negative sign of the FDI coefficient signifies low environmental degradation and carbon emissions rejecting the pollution haven hypothesis. Although FDI's inflow from 2000 to 2014 did not focus directly on the Environmental sectors of the selected countries. Sectors such as energy and transportation which have received a major boost will translate to reduced emissions through a proper transfer of clean technologies.

b) We find no evidence of Carbon emission and forest product export from the selected FOCAC countries which adds up to the academic debate on the complexity of forest products and carbon emission studies.

c) GDP and energy use which are synonymous with economic growth are positive as evidenced in the literature. Since most of the selected countries are at their initial industrialization stage, it is not surprising that a significant rise in emissions will be reached however with the intensification of institutions and proper technologies investment through FDI's as specified in the FOCAC agreement, the anticipated adverse impact can be reversed.

d) Finally, institutions that form the basic foundation of economic growth also proved significant in shaping carbon emission levels in the selected countries. In this context, the FOCAC agreement uniquely provides strong institutional platforms where sustainable forest product trade can be reached for mutual benefit.

Policy implication

The findings reveal that the selected African states are not pollution havens for China in term of forest product trade but rather aligns with the halo hypothesis which provides an understanding of the potential merits and demerits of the growing relationship between China-FOCAC members. Also, the findings divulge the keen significance of China and Africa in the context of FOCAC towards achieving the 2030 environmental sustainability goals concerning forest product trade. We, therefore, propose the following insightful policy suggestions for countries within the FOCAC agreement.

FDI allocation

Since properly managed FDI inflow is proven as a potential driver of economic growth and low carbon emission for emerging economies, FOCAC countries should embrace FDI's that centres on enhancing environmental quality, clean and efficient energy use.

Government and Institutions

To avoid FDI's from swallowing economics such as that of Zambia, Strong institutions that offer strict monitoring of projects delivered by FDIs need to be strengthened. Additionally, Governments and policymakers in FOCAC countries to promote peace and a stable environment to attract potential investors.

Researchers and Academia

As supplementary evidence to the contrasting views on the role of forests in shaping the environment, this current contribution to the limited literature on China-Africa engagement in the context of environmental merits and demerits associated with the increased forest products exports to China. However, since this study only focuses on total forest exports from selected countries, detailed work that focuses on the imports and exports and carbon emissions is recommended.

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