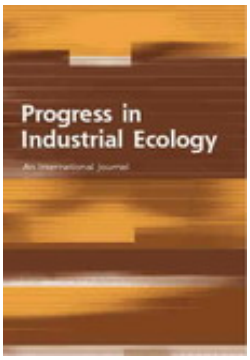
INDERSCIENCE PUBLISHERS
Linking academia, business and industry through research



Progress in Industrial Ecology, An International Journal

ISSN online: 1478-8764 - ISSN print: 1476-8917
https://www.inderscience.com/pie

The paradox of regional integration and sustainable development: perspectives from West Africa

Sodiq Olaiwola Jimoh, Rashidat Sumbola Akande, Hauwah K.K. Abdulkareem

Article History:

Received:	28 April 2022
Last revised:	29 April 2023
Accepted:	07 July 2023
Published online:	18 December 2023

The paradox of regional integration and sustainable development: perspectives from West Africa

Sodiq Olaiwola Jimoh,
Rashidat Sumbola Akande* and
Hauwah K.K. Abdulkareem

Department of Economics and Development Studies,
Kwara State University,
PMB 1530, 23431, Malete,
Kwara State, Nigeria
Email: sodiq.jimoh@kwasu.edu.ng
Email: rashidat.akande@kwasu.edu.ng
Email: hauwah.kamaluddeen@kwasu.edu.ng
*Corresponding author

Abstract: Although opportunities abound for the achievement of Sustainable Development Goals (SDGs) with regional integration, West Africa has not been able to fully harness the potential gains of regional integration. This study examines the extent to which regional integration drives sustainable development in West African countries from 1980 to 2019. This study specifies a Cobb-Douglas-type production function that expresses output as a function of capital and labour, which is augmented with trade integration. Adopting the dynamic common correlation effects (DCCEs) method as the estimation technique, results show that labour and capital stock have a significant positive impact on sustainable development, while trade integration is found to have a negative impact on sustainable development. Although the result is contrary to expectations, it reflects the current reality of the state of regional trade in the region, as well as the attendant slow progress in the achievement of SDGs.

Keywords: regional integration; sustainable development; Sustainable Development Goals; SDG; African Continental Free Trade Area; AfCFTA; West Africa.

Reference to this paper should be made as follows: Jimoh, S.O., Akande, R.S. and Abdulkareem, H.K.K. (2023) 'The paradox of regional integration and sustainable development: perspectives from West Africa', *Progress in Industrial Ecology – An International Journal*, Vol. 16, No. 4, pp.213–229.

Biographical notes: Sodiq Olaiwola Jimoh is a Lecturer and researcher at the Kwara State University, Nigeria, specialising in International Economics. He obtained his PhD in International Economics from the Universiti of Sains Malaysia in 2022. His research interests encompass economic integrations, sustainable development, trade, and finance. He has made significant contributions to the field through his publications in reputable national and international journals, focusing on international macroeconomics. Moreover, he has actively served as a reviewer for esteemed journals, demonstrating his commitment to advancing scholarship in the field of international economics.

Rashidat Sumbola Akande is an Economics Lecturer at the Kwara State University, Malete, Nigeria. Her broad area of research interest is on sustainable economic development with a focus on the informal sector, women and gender studies, labour and human capital development and poverty alleviation. She received her MSc in Finance and Economics from the University of Southampton, UK and recently completed her PhD in Economics at the Kwara State University, Nigeria. She is currently a Queen Elizabeth Scholar – West Africa at Carleton University, Canada.

Hauwah K.K. Abdulkareem is a Development Economist and a research fellow in the Department of Economics and Development Studies, Kwara State University, Malete, Nigeria. She is a West African Research Association (WARA) Grant Awardee (Ideas Matter Doctoral Research Fellow, 2019), a Grooming Centre University Grant Recipient (2019), and a 2020 PhD Thesis Award Winner of the Nigerian Economic Society (NES). She has authored and co-authored several scholarly publications in reputable national and international peer reviewed journals, publishing widely in her area of expertise – development economics, with interest in research themes around gender, poverty, financial inclusion, and sustainable development. She also serves as a reviewer for high-ranking international journals in economics and development.

1 Introduction

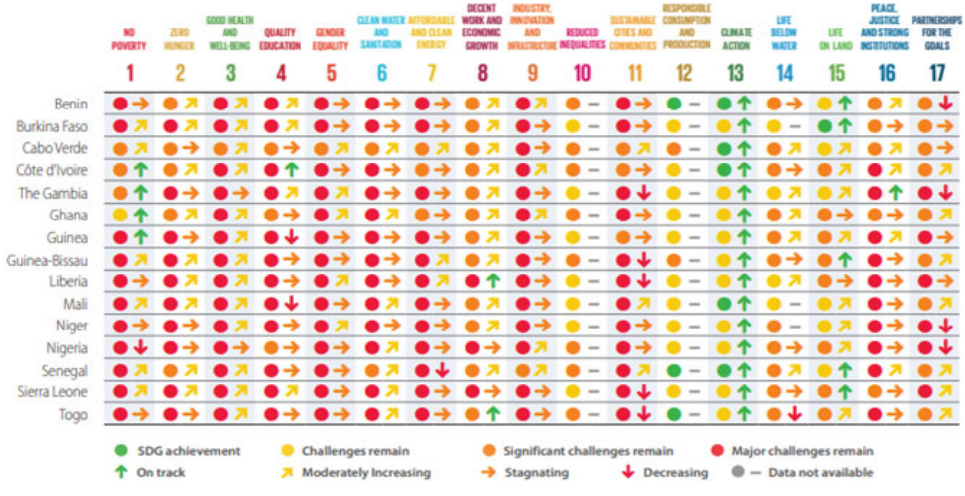
In the race to achieve the Sustainable Development Goals (SDGs) by 2030, which is less than a decade away, regional integration becomes vital to account for environmental needs in the economic and social goals of development. As a manifestation of globalisation, regional integration is regarded not only as a concerted effort towards development but also as a vehicle to achieve higher levels of development than would have been possible otherwise. However, to fully realise the gains of regional integration for economic transformation and sustainable development, an all-inclusive analysis of the implementation processes and strategies peculiar to the regional context is critical (Babenko et al., 2020). Prerequisites such as comparable levels of economic development, challenges, and territorial proximity have been identified as crucial to the creation of regional integration in order to achieve rapid GDP growth, increased productivity, regional trade markets, and convergence of macroeconomic indicators necessary for the attainment of SDGs (Yakubovskiy et al., 2019).

The regional body for West Africa, the Economic Community of West African States (ECOWAS), was established as part of the regional development efforts of 15 countries namely, Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo. The integrated economic activities of ECOWAS on agriculture, energy, industry, social and cultural issues, and natural resources realigned with SDG 2 (zero hunger), SDG 7 (affordable and clean energy), SDG 9 (industry, innovation, and infrastructure), SDG 11 (sustainable cities and communities), and SDG 12 (responsible consumption and production), respectively. Despite these efforts and interrelationships, progress on the SDG in the West African region has been abysmal.

The 2020 SDG trends and dashboard for West Africa, as depicted in Figure 1, show that the region is on track to achieve only one goal: SDG 13, which is climate action.

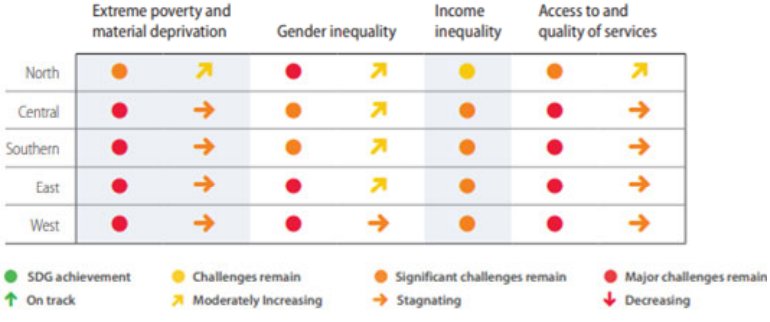
Even for this goal, most countries save for Benin, Cabo Verde, Cote d'Ivoire, Mali, and Senegal have inherent challenges that may hinder the achievement of the goal, even though they are presently on track. Unfortunately, for most goals, the region is experiencing stagnation with major challenges. Nigeria, for instance, is experiencing stagnation in goals 2, 3, 4, 6, 7, 8, 11, 14, and 16; deterioration in goals 1 and 17; and a moderately increasing trend in goals 6, 9, and 15.

Figure 1 West Africa SDG and trends dashboard (see online version for colours)



Source: Sustainable Development Solutions Network (2020)

Figure 2 LNOB sub-regional dashboard (see online version for colours)



Source: Sustainable Development Solutions Network (2020)

In terms of inequalities, which is captured by the 'leave no one behind' (LNOB) principle of the SDGs in Figure 2, the West African region is faring the worst even though Africa as a whole is faring poorly. Figure 2 reveals that West Africa is experiencing stagnation in each of the indicators. Consequently, this constitutes a major challenge for the achievement of the objectives of ECOWAS as West Africa's regional bloc, and has dire consequences for the achievement of the SDGs in the region.

It is in view of this that this paper examines the extent to which regional integration drives sustainable development in West Africa from 1980 to 2019. This study contributes

to the literature in several ways. First, despite the importance of regional integration in sustainable development, this interconnection has not enjoyed adequate attention in the mainstream literature with studies conducted for Africa even more limited. Thus, this study is among the few in mainstream journals that investigate the effect of regional integration on sustainable development, especially in the West African context. The West African region is particularly lagging behind in reaping the sustainable development benefits of regional integration as expounded above. This necessitates this study with a view of proffering practical strategies to boost the attainment of SDGs in the region which has important implications in terms of poverty reduction and improved quality of life for about half a billion people (World Bank, 2023).

Second, most studies in the area focus on policy integration (e.g., Le Blanc, 2015; Boas et al., 2016) or simply explore certain aspects of sustainable development such as energy sustainability (Akinyemi et al., 2019) or economic growth such as Ogbuabor et al. (2019), Tumwebaze and Ijjo (2015) and Zaman et al. (2021). This study fills this lacuna by focusing on sustainable development in totality thereby conducting a more comprehensive analysis. All aspects of sustainable development is considered with the use of adjusted net savings (ANSs) which is genuine savings after considering human capital investment, natural resource depletion and environmental, and degradation. By adopting ANS as a measure of sustainable development, this study advances the frontiers of knowledge by introducing an all-encompassing measure of sustainable development which other studies have not employed in their analysis of regional integration and sustainability.

Third, even though recent studies like Sheraz et al. (2021) and Ullah et al. (2021, 2022b) have explored the effects of regional integration on sustainable development, the former was employed as an interactive variable, not the main variable of interest. More so, these studies were limited in their measurement of regional integration, using dummy variable to measure periods of integration. The present study uses trade integration as a measure of regional integration which has two major advantages. First, it is the most common measure of regional integration (Bouët et al., 2017) and second, trade, links countries together more than other macroeconomic variables (Korhonen and Ledyaeva, 2010). Using trade integration therefore, allows for proper assessment of the exact nature of regional integration among the West African countries since it measures the intra-regional trade share of individual countries.

This paper is structured into five sections, with the introductory part as the first. Section 2 reviews the relevant literature, while the Section 3 elucidates the methodology of the study. In Section 4, the results of the empirical analysis are presented and discussed, and conclusions and policy recommendations are provided in Section 5.

2 Literature review

Sustainable development is a type of development that is in an intersection between the social, economic, and environmental goals of an economy. According to the Brundtland report published in 1987, sustainable development requires meeting today's needs without compromising that of the future generations. Regional integration involves the coming together of countries with similar interest to achieve a common goal. It focuses on ensuring conflict-free coexistence among countries and developing effective cooperation (Babenko et al., 2020).

2.1 Theoretical background on sustainable development and regional integration

Theories of sustainable development on one hand explain how society can achieve a balance between economic, social, and environmental goals. Central to the debate on sustainable development is how an economy can manage today's resources in such a way that it would not jeopardise those of future generations. Sustainable development can therefore be linked to neoclassical growth model, more specifically, the role of savings in capital accumulation in the Solow (1956) growth model. To understand the optimum level of savings that would maximise the steady state level of growth of consumption, Phelps (1961) came up with the golden rule of capital accumulation – which is the level of capital that would provide the most consumption at each period. Chichilnisky et al. (1995) introduced the green golden rule (GGR) by including concept of environment into the golden rule. Here, the authors provided the highest maintainable level of consumption that would allow for environmental renewal. As an extension of the GGR, Ayong Le Kama (2001) presented a growth model that has environmental resources as a source of input and utility to production. The study introduced a negative externality with a zero-discount rate to solve for an optimal growth path that converges to the GGR. In the endogenous growth tradition, Rivera-Batiz and Romer (1991) introduced two different specification of integration into the growth model and it is found that economic integration can lead to an increase in the return to scale in the research and development sector and hence, increase long-run rate of growth.

On the other hand, regional integration theory explains how cooperation among countries can improve the growth and socioeconomic welfare of the countries involved. According to Gammadigbe (2021), the theory of regional integration is associated with the theory of international trade. The central idea behind regional integration is the elimination of trade barriers to allow free flow of economic resources among member states. Trade integration therefore, enables trade openness and improves the welfare and growth of member states. The theory of economic integration concentrated in regions can be traced down to the study of Krugman (1991). This study applied the theoretical background of industrial organisations to create a model of the geographical concentration of manufacturing firms in regions with larger demands to benefit from economies of large scale and minimise transport costs. Similarly and as an extension of the study of Krugman (1980), Melitz (2003) developed a dynamic industrial model which incorporates heterogeneity among firms to analyse the effect of trade on intra-industry and aggregate industrial productivity. The model shows that trade liberalisation increases trade exposure, reduces trade costs, and increases welfare gains, even though trade exposure forces less-productive firms out of the market. As a result of this process, there is a transfer of resources from firms with lower productivity to those with higher productivity.

2.2 Empirical evidence

Empirical analysis on the effect of regional integration on sustainable development have been explored in different ways in literature, with some of the research focusing only on a specific aspect of sustainable development such as energy and environmental sustainability as in the study of Akinyemi et al. (2019) or economic growth as a measure

of sustainability as in the works of Ogbuabor et al. (2019), Tumwebaze and Ijjo (2015) and Zaman et al. (2021) and that of some of the more recent studies have explored regional integration on sustainable development as one measure like Sheraz et al. (2021) and Ullah et al. (2021, 2022b) but they are not without their limitations.

Berthelon (2004) analysed the growth effect of regional integration agreement (RIA) across different countries in different regional agreement. The author introduced a new measure of RIA by interacting the country's membership in RIA with their partner's share of world GDP, as opposed to the use of dummy variables in other studies. The data used was a cross country panel covered a period of 1960–1999 which was estimated using the panel regression analysis method. The result indicated a RIA have positive effect on growth, with the North-North agreement having significant growth effect and the South-South and North-South having ambiguous effects. Similarly, Zaman et al. (2021) employed a two-step system GMM method to analyse the influence of IT exports, gross capital formation, FDI, and trade openness on sustainable economic growth with regional integration of BRI countries spanning from 2013 to 2018. The findings indicate that FDI and gross capital formation exert a significant and positive influence on economic growth, while IT exports and trade openness have an insignificant and negative impact. Some other authors focused of specific regional agreement as in the work of Tumwebaze and Ijjo (2015) which examined the contributions of the Common Market for the Eastern and Southern Africa (COMESA) integration to the economic growth of the region. The study adopted the instrumental variable GMM regression method to analyse annual panel data for the period from 1980 to 2010. Contrary to a priori expectations, the results found no evidence to support the existence of a positive effect of integration on economic growth in the region. Similarly, Ogbuabor et al. (2019) also studied a specific regional integration by analysing its effects on economic growth. The study focused on the integration of the West African Economic and Monetary Union (WAEMU) with the aim of investigating the contribution of integration to the economic growth of member states. Using annual panel data from 2000 to 2015 and dummy variables to represent countries' participation in WAEMU, the study adopted the robust instrumental variable GMM regression as the method of analysis. The results suggest no evidence that WAEMU integration has a positive effect on economic growth. Other factors found to drive growth include foreign direct investment (FDI) and institutional quality. The policy recommendation suggests continuous institutional reforms and the improvement of the social and political environment of WAEMU countries to enable inclusive and sustainable development.

While explaining the importance of interlinkages and interdependence of the SDGs for implementation, Stafford-Smith et al. (2017) suggest paying attention to three interlinkages – across sectors, across societal actors and between and among countries. As part of the recommendations for ensuring successful implementation of the SDGs, the authors documented that the current trade system and liberalisation policies are detrimental for poverty and sustainable development. Trade systems and policies should be linked across countries and sectors at all levels to promote trade in the appropriate products and services for sustainable development.

Viewing sustainability from the perspective of energy and the environment, Akinyemi et al. (2019) investigated the potential of regional integration as a means of promoting energy sustainability within the ECOWAS. The study employed a descriptive analytical approach, utilising three metrics of energy sustainability: energy security, energy equity, and environmental sustainability. The primary objective of the research

was to explore the opportunities and challenges associated with the integration of energy systems among ECOWAS member countries. The study revealed that there are prospects as well as challenges of energy integration for sustainable development and recommends investment in human capital as well as political will to create an enabling environment for the achievement of the set goals of member states.

Babenko et al. (2020) also examined the prospects of economic integration for Ukraine with the European Union as a means of ensuring sustainable development for the country. The study explored the trend in the volume of trade between Ukraine and EU countries and found that trade volume has increased in recent times, indicating potential benefits from trade integration. Aside from trade, this study identified that technology and knowledge spillover would occur if the country became a member of the EU. The study also identified possible threats and recommended that the country take advantage of the positive aspects of integration while developing an action plan to mitigate the negative consequences of economic integration.

Some recent studies focused on regional integration as moderating variables with the effect of other variables on sustainable development. The moderating variable helps to examine how the relationship between these variables and economic growth changes with regional integration. Ullah et al. (2021) examines the relationship between regional integration, socioeconomic determinants, and sustainable development in Belt and Road countries from 2003–2018. The study adopted the two-step system generalised method of moments (GMM) to estimate the model and finds that human development, health expenditure, and age structure have a positive impact on sustainable development, while e-government, government size, and globalisation have a negative impact. The moderating effect of regional integration is found to be positive. Similarly, Ullah et al. (2022a) examined how the utilisation of e-government resources affects sustainable development in 64 Belt and Road countries, considering the moderating role of the multi-dimensional regional integration index. Based on the theoretical foundations of Solow growth model and Cobb Douglas production function, the study employed a two-step system GMM to estimate the findings. The results show that while direct e-government resource utilisation has a negative impact on sustainable development, indirect utilisation through multi-dimensional regional integration has a positive impact. The study suggests that a robust e-government system in the presence of regional integration can promote sustainable development in the post-COVID-19 pandemic period. These two studies however used dummy variables to measure regional integration and did not consider the direct effect of regional integration except as a moderating variable for the effect of other variables on sustainable development.

A study that focused on the direct effect of regional integration is that of Ullah et al. (2022b) which emphasised the significance of integration as a crucial determinant of sustainable development in 64 countries associated with the Belt and Road Initiative (BRI). By adopting the two-step system of GMM validated through two-stage least square (2SLS), the research revealed that the integration of before and after BRI dummy has a positive effect on sustainable development. The research also revealed that sustainable development is positively influenced by factors such as financial development, energy efficiency ratio, per capita health expenditure, per capita income growth, and good governance. Conversely, the study identified e-government, natural resource rent, macroeconomic conditions, and government size as factors that negatively affect sustainable development. The limitation of this study is in the measurement of

regional integration. The study used dummy variable to measure the before and after integration of the BRI countries which may not capture the full complexity of the integration process and may not account for the heterogeneity of the integration effects as well as intertemporal changes across different regions or countries. Alternatively, our study used the direction of trade flows as a measure of regional integration, which is quantifiable and gives a better information about the degree of integration among these countries.

From the review of literature, it is evident that past work is limited in scope and measurement of regional integration and sustainable development. Many of these studies have not dwelled on the sustainable development effect of regional integration, particularly in West Africa. Some of them focused on a limited measure of sustainable development and regional integration while some picked interest on policy integration. Based on these limitations, this study fills the gaps by exploring the effect of regional integration on sustainable development in West Africa. The study also used the direction of trade flows as a better and more comprehensive measure of regional integration. Finally, this study fills a methodological gap in literature by adopting the dynamic common correlation effects (DCCEs) method of Chudik and Pesaran (2015) to estimate the model of the effect of regional integration and sustainable development.

3 Materials and methods

The study utilises a Cobb-Douglas type production function to depict the relationship between output, capital, and labour. In addition, the function is augmented by including trade integration as a determinant of output.

$$Q_{it} = f\left(K_{it}, L_{it}, TI_{it}\right) = K_{it}^{\alpha_1} L_{it}^{\alpha_2} TI_t^{\alpha_3} \tag{3.1}$$

where Q, K, L and TI denotes output, capital, labour, and trade integration, respectively. The shares of the output with respect to each of the explanatory variables are denoted by $\alpha_1 - \alpha_3$. Log-linearising equation (3.1) produced equation (3.2), below:

$$\ln Q_t = \alpha_0 + \alpha_1 \ln K_{it} + \alpha_2 \ln L_{it} + \alpha_3 \ln TI_{it} + \mu_{it} \tag{3.2}$$

where μ_{it} denotes the stochastic error term.

To empirically analyse the impact of trade integration on sustainable development, ANSs is substituted for output in equation (3.2) to produce (3.3), as follows:

$$\ln ANS_{it} = \alpha_0 + \alpha_1 \ln K_{it} + \alpha_2 \ln L_{it} + \alpha_3 \ln TI_{it} + \mu_{it} \tag{3.3}$$

ANS is a composite index defined as

$$ANS = NNS + ED^{\exp} - CO_2^E - FK^c - ER^d - MR^d \mp F^d \tag{3.4}$$

where NNS, $ED^{\exp}$, CO_2^E, FK^c, ER^d, MR^d and F^d represent net national savings, education expenditure, carbon dioxide damage, consumption of fixed capital, energy resources depletion, mineral resources depletion and forest depletion, respectively (Hamilton and Clemens, 2011). The ANSs was substituted for output because it could serve as a measure of output and sustainable development (Solarin and Bello, 2019).

From equation (3.5), TI_i is the intra-regional trade share of an individual country; T_{ij} is the sum of exports and imports of countries i and j within West Africa; and T_j is the trade volume of West Africa to the rest of the world (He et al., 2021; Ejones et al., 2021; Jimoh and Chua, 2021). Trade integration is used as a measure of regional integration because trade links countries together than other macroeconomic variables (Korhonen and Ledyaeva, 2010). In addition, trade integration is the most common measure of regional integration (Bouët et al., 2017).

$$TI_i = \frac{T_{ij}}{T_j} \tag{3.5}$$

The detailed descriptions, measurement and variables sources are presented in Table 1.

Table 1 Description of variables and data source

Variables	*Description*	*Unit of measurement*	*Sources*
ANS	Adjusted net savings	Percentage of GNI	World Development Indicators
K	Stock of capital	Measured in millions USD2,017	Penn-World Table 10.0
L	Number of labour employed	Millions of USD	Penn-World Table 10.0
TI	Trade integration	Measured in millions of USD	IMF Direction of Trade Statistics

Source: Authors' computation (2022), This study used annual data from 1980 to 2019

This study focuses on West Africa because the region is considered home to many of the world's poorest countries, and sustainable development is critical for reducing poverty and improving the quality of life for millions of people in the region. Also, the region has been undergoing various regional integration initiatives aimed at promoting economic development and reducing barriers to trade.

3.1 Estimation method

This study adopts the DCCEs method to examine the impact of regional integration on sustainable development. This method is used because the existing literature fails to account for the role of cross-sectional dependence in non-stationarity panels, which may lead to misleading results. Chudik and Pesaran (2015) introduced the DCCE approach, which considers homogenous and heterogeneous coefficients and considers cross-sectional dependence, which is peculiar to panel analysis with large N and T (Meo et al., 2020). Another advantage of this technique is that it produces good results with an unbalanced panel data (Ditzen, 2018). The dynamic equation of the DCCE employed in this study is shown in equation (3.6).

$$ANS_{it} = \alpha_i ANS_{it-1} + \delta_i x_{it} + \sum_{P=0}^{P_T} \gamma_{xip} \bar{X}_{t-p} + \sum_{P=0}^{P_T} \gamma_{yip} \bar{Y}_{t-p} + \mu_{it} \tag{3.6}$$

where ANS_{it} and ANS_{it-1} represents the ANSs and its lag, respectively. x_{it} is a set of explanatory variables used in this study, while P_T is the lag limits included in cross-sectional averages.

4 Results and discussion

Table 2 presents the summary statistics of the variables used in this study in terms of the mean, standard deviation, and minimum and maximum observations. The average mean of ANS is 6.3%, which is an indication that the average ANSs of the West African region is low when compared to other regions pursuing collective SDGs. This is consistent with Figure 2, which shows that the region is experiencing stagnation in most SDGs. The average stock of capital (*K*) indicates that the region has improved in the financial markets due to an improved portfolio and FDI in recent years. The average value of labour 0.7 is a reflection of the high level of unemployment in the region, while trade integration's mean reveal the level at which West African countries trade with one another. The mean value of TI is an indication that West African countries are import-oriented as they import from the rest of the world rather than export.

Table 2 Summary statistics

Variable	*Obs.*	*Mean*	*Std. dev.*	*Min*	*Max*
ln*ANS*	640	6.348141	0.562187	4.043051	6.929517
ln*K*	640	10.4072	1.610363	7.7094	14.95188
ln*L*	640	0.73642	1.336969	–2.36903	4.290741
ln*TI*	640	4.376745	1.718972	–3.10109	8.097358

Source: Authors' computation (2022)

Table 3 Pairwise correlation

	lnANS	*lnK*	*lnL*	*lnTI*
ln*ANS*	1			
ln*K*	0.3065***	1		
ln*L*	0.3718***	0.8097***	1	
ln*TI*	0.3725***	0.5367***	0.7488***	1

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: Authors' computation (2022)

The relationship between the variables used in this study, as depicted by the correlation coefficients in Table 3, reveals a significant relationship among the variables used in this study. The coefficient of correlation ranges between –1 and 1. The relationship between capital and labour produced the highest correlation coefficient (0.8097), while the relationship between capital and ANSs has the lowest correlation coefficient (0.3065). The correlation coefficients also suggest that there is no likelihood of multi-collinearity among variables.

The result of the panel unit root test is presented in Table 4. This study employed first- and second-generation unit root tests to ascertain the level of integration of the variables used. The LLC, IPS and Breitung represent Im et al. (2003), Levin et al. (2002)

and Breitung (2000) which are the first generation panel unit root tests, respectively. The Pesaran (2021) represents the second generation panel unit root test employed in this study. The major distinct feature between the two generations tests is that the latter considers the role of cross-sectional dependence in non-stationarity panel studies. The panel unit root tests indicate that the order of integration of the series is $I(1)$ and $I(0)$, respectively. This means that the variables are either stationary at level or at first difference.

Table 4 Unit root test

Variables	*LLC*	*IPS*	*Breitung*	*Pesaran*
Level				
ln*ANS*	–5.8687	–3.1403***	–2.6945**	–2.836***
ln*K*	2.4767	2.8705	16.8341	–1.574
ln*L*	0.2910	0.1908	18.9810	–2.448*
ln*TI*	–	–1.6814*	–	–3.618***
First difference				
ln*ANS*	–19.4677***	–7.1181***	–6.5670***	–4.710***
ln*K*	–6.9737*	–2.7565***	–1.8364***	–2.997***
ln*L*	–8.8696**	–3.3008***	–3.3231***	–2.321*
ln*TI*	–	–7.8628***	–	–13.755***

Notes: ***, ** and * denote significance at 1%, 5% and 10% respectively.

Source: Authors' computation (2022)

Table 5 Panel cointegration test

Pedroni cointegration	*Statistic*	*P-value*
Modified Phillips-Perron *t*	–2.7114	0.0033
Phillips-Perron *t*	–7.5949	0.0000
Augmented Dickey-Fuller *t*	–6.9659	0.0000
Kao cointegration	*Statistic*	*P-value*
Modified Dickey-Fuller *t*	–1.7059	0.044
Dickey-Fuller *t*	–1.8425	0.0327
Augmented Dickey-Fuller *t*	–0.1888	0.4251
Unadjusted modified Dickey Fuller *t*	–6.2196	0.0000
Unadjusted Dickey-Fuller *t*	–3.9368	0.0000

Source: Authors' computation (2022)

This study employed the panel cointegration tests to ascertain the long-run relationship among the variable used in this study. The panel cointegration tests in Table 5 indicate a long-run relationship between the variables used in this study. This is indicated by the probability values of the Kao and Pedroni tests which are less than the significant levels.

Cross-sectional dependence test is often used to detect whether there is any form of dependence between observations in a sample that were collected at the same time point. The test is important in econometrics, where it is used to assess whether the assumptions of independent and identically distributed (i.i.d) errors hold, which is crucial for reliable

estimation of statistical models. This study employs Frees and Friedman's test to check for the presence of cross-sectional dependence among the variables used. The cross-sectional dependence tests in Table 6 reveal that cross-sectional dependence is present between the units of the cross-sections, as the null hypothesis of cross-sectional independence is rejected.

Table 6 Cross sectional dependence

Test	*P values*
Frees	0.0000
Friedman	0.0003

Source: Authors' computation (2022)

Table 7 DCCE estimates

Variables	*PMG*	*P-value*	*DCCE*	*P-value*
ln*ANS*(–1)			–1.0637	0.000***
ln*K*	0.1807	0.021**	1.2247	0.046**
ln*L*	–0.1185	0.030**	0.5981	0.002***
ln*TI*	–0.0029	0.063*	–0.1944	0.003**
C	1.7787	0.000***	9.0131	0.000***
R^2				0.41

Notes: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Source: Authors' computation (2022)

Table 7 shows the estimates of the pooled mean group and dynamic common correlation models. The PMG estimates in Table 7 show that capital has a positive and significant impact on sustainable development, while labour and trade integrations have a negative and significant impact on sustainable development. This means that an increase in capital increases sustainable development, while an increase in labour and trade integrations reduces sustainable development in the West African region. However, the presence of cross-sectional dependence in Table 6 above suggests that PMG is not an ideal estimation technique for this study as it does not accommodate the cross-sectional dependent issue. Therefore, its estimates could provide a misleading outcome.

The estimates of the DCCE in Table 7 show that labour and capital stock have a significant positive impact on the sustainable development, while trade integration has a negative impact on sustainable development. A percentage increase in capital stock and labour spurs sustainable development by 1.22% and 0.59%, respectively. On the other hand, a percentage increase in trade integration reduces sustainable development by 0.19. A positive impact of capital stock on sustainable development is expected as it would ease the attainment of most SDGs such as income inequality, economic growth, zero hunger and industry, innovation and infrastructure. This finding contradicts (Solarin and Bello, 2019), which found a negative association between capital stock and sustainable development in Brazil. The coefficient of labour also produced a positive and significant impact on sustainable development in the West African region. This result is somewhat surprising because it is evident that most West African countries have a high unemployment rate, which is expected to hinder the growth and attainment of some SDGs. However, strong trade liberalisation has made it easier for labour to move from

deficit to surplus countries within the region. This could reduce income inequality and hunger in the region.

The coefficient of trade integration in Table 7 shows that trade integration has a negative impact on sustainable development in West Africa. Although the result is contrary to expectations, it reflects the current reality of the state of regional trade in the region, as well as the attendant slow progress in the achievement of SDGs. The result also agrees with Stafford-Smith et al. (2017) who documented that trade liberalisation, policies and structures are typically detrimental to sustainability. This indicates that despite the recent adoption of the AfCFTA among African countries that West Africa is a significant part of, which was designed to achieve structural transformation and the attainment of sustainable development, the SDG goals remain stagnant in most West African countries. However, the caveat here is that the gains of AfCFTA are yet to be felt, as the agreement was signed a little over a year ago and negotiations are still ongoing. Also, AfCFTA is not implemented uniformly, is taking off in phases, and is yet to be concluded. The COVID-19 pandemic, according to the Secretary-General, has also slowed progress on the implementation of the free trade agreement, both at the level of the AfCFTA Secretariat and in 42 countries that were in lockdown (UN, 2022).

Moreover, the negative impact of trade integration on sustainable development in the West African region could also be a result of non-consideration of environmental factors in the formulation and implementation of policies, which may make intra-regional trade hinder the attainment of collective sustainable development. Furthermore, participating countries in the current regional integration arrangement do not have comparable levels of economic development, which is a requisite for regional integration (Yakubovskiy et al., 2019). Presently, West African countries have varied levels of economic development and industrial capacity, which positions some countries ready for AfCFTA take-off with others unready (UN, 2022).

The long-run coefficient of the DCCE model also shows that the lagged level dependent variable is negative and significant, confirming the long-run cointegrating relationship, while the coefficient of determination shows that 41% of the variations in sustainable development are explained by the explanatory variables used in this study.

5 Conclusions and policy implications

This paper examines the extent to which regional integration drives sustainable development in West Africa using a Cobb-Douglas type production function which is augmented with trade integration to depict the relationship between output, capital, and labour. The DCCE method of Chudik and Pesaran (2015) is used to as the estimation technique. Findings show that labour and capital stock have a significant positive impact on sustainable development, while trade integration has a negative impact on sustainable development. Although the result is contrary to a priori expectations, it reflects the current reality of the state of regional trade in the region as well as the attendant slow progress in the achievement of SDGs.

This has several policy implications. First, West African countries need to improve on trade integration within the region. Presently, there is low level of trade among the countries of the region in addition to them being import-oriented as evidenced in the mean value of trade integration in the region which is about 4.4% (see Table 2).

Therefore, there is need for deliberate effort to improve on value added products and boost production of internationally competitive goods for export promotion and intra-regional trade expansion. Production of complementary goods and services will also facilitate intra-regional trade (Oyejide, 2000). We also recommend that members of regional economic blocs align national plans and policies with that of regional plans to avoid conflicting and counter-intuitive outcomes and ensure they benefit maximally from the gains of regional integration.

In addition, it is important that regional trade is conducted in a sustainable manner to protect the environment (Shah et al., 2022). Countries need to adopt green production methods and technologies for export production. In becoming more export-oriented, renewable energies such as solar and hydropower should be adopted for manufacturing of exports product and the production of goods for import-substitution to reduce CO_2 emissions and environmental pollution. This will have a direct influence on the achievement of SDGs 11 and 13 and an indirect effect on SDGs 1, 2, 3, 7 and 12 (Abdulkareem et al., 2022). Furthermore, is the need to invest heavily in research and development in order to be well equipped with the knowledge, technology, infrastructure and institutions required to fully exploit the sustainable development gains of regional integration. One of the areas countries may consider in this regard is in the aspect of green transportation modes for trading activities.

From the perspective of AfCFTA which is the trade integration applicable to the West African region, it is recommended that West African countries yet to commit to AfCFTA speed up deliberations and processes and ratify the agreement. Notwithstanding the initial challenges, AfCFTA is positioned to boost sustainable development in West Africa given the progress recorded so far. A recent report by the UN (2022) indicates that progress has been made in the areas of number of countries that ratified the agreement (39 in numbers), agreement on the rules of origin and products of about 88% and 80%, respectively, and operationalisation of the protocol on dispute settlement.

For countries that already signed the agreement, their governments need avowed commitment and careful implementation of the policies and rules. These are critical to the success of the agreement in order to maximise the potential gains of AfCFTA. This is important to achieve rapid GDP growth, increased productivity and convergence of macroeconomic indicators necessary for the attainment of sustainable development (Yakubovskiy et al., 2019). Lastly, it is crucial that governments and the AfCFTA Secretariat ensure constant monitoring in all areas of the agreement to ensure strict compliance to trade rules of origin, products and protocols.

This study has a few limitations. First, is in terms of scope which focuses on the West African region. Future studies can therefore extend the scope to other regions of the African continent to see how the results compare with that of West Africa given that the same trade integration of AfCFTA applies to other regional blocs in Africa as well. More so, with constant progress on the AfCFTA and more countries ratifying the agreement, more studies will be required in this direction to provide an empirical basis for further progress recorded in its implementation. Second, this study used ANSs to proxy sustainable development. We therefore, suggest other researchers adopt other measures for sustainable development such as the Sustainable Development Index (SDI) which accounts for the ecological efficiency of the Human Development Index (HDI).

References

Abdulkareem, H.K.K., Jimoh, S.O. and Shasi, O.M. (2022) 'Socioeconomic development and sustainable development in Nigeria: the roles of poverty reduction and social inclusion', *Journal of Business and Socioeconomic Development* https://doi.org/10.1108/JBSED-10-2021-0137.

Akinyemi, O., Efobi, U., Osabuohien, E. and Alege, P. (2019) 'Regional integration and energy sustainability in Africa: exploring the challenges and prospects for ECOWAS', *African Development Review*, Vol. 31, No. 4, pp.517–528 https://doi.org/10.1111/1467-8268.12406.

Ayong Le Kama, A.D. (2001) 'Sustainable growth, renewable resources and pollution', *Journal of Economic Dynamics and Control*, Vol. 25, No. 12, pp.1911–1918 https://doi.org/10.1016/S0165-1889(00)00007-5.

Babenko, V., Perevozova, I., Kravchenko, M., Krutko, M. and Babenko, D. (2020) 'Modern processes of regional economic integration of Ukraine in the context of sustainable development', *E3S Web of Conferences*, Vol. 166 https://doi.org/10.1051/e3sconf/202016612001.

Berthelon, M. (2004) *Growth Effects of Regional Integration*, Central Bank of Chile Working Papers, No. 278, pp.1–40.

Boas, I., Biermann, F. and Kanie, N. (2016) 'Cross-sectoral strategies in global sustainability governance: towards a nexus approach', *Int. Environ Agreements: Politics, Law and Economics*, Vol. 16, pp.449–464.

Bouët, A., Cosnard, L. and Laborde, D. (2017) 'Measuring trade integration in Africa', *Journal of Economic Integration*, Vol. 32, No. 4, pp.937–977.

Breitung, J. (2000) 'The local power of some unit root tests for panel data', *Advances in Econometrics*, Vol. 15, pp.161–177 https://doi.org/10.1016/S0731-9053(00)15006-6.

Chichilnisky, G., Heal, G. and Beltratti, A. (1995) 'The green golden rule', *Economics Letters*, Vol. 49, No. 2, pp.175–179 https://doi.org/10.1016/0165-1765(95)00662-Y.

Chudik, A. and Pesaran, M.H. (2015) 'Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors', *Journal of Econometrics*, Vol. 188, No. 2, pp.393–420 https://doi.org/10.1016/j.jeconom.2015.03.007.

Ditzen, J. (2018) 'Estimating dynamic common-correlated effects in Stata', *Stata Journal*, Vol. 18, No. 3, pp.585–617 https://doi.org/10.1177/1536867x1801800306.

Ejones, F., Agbola, F.W. and Mahmood, A. (2021) 'Regional integration and economic growth: new empirical evidence from the east African community', *The International Trade Journal*, Vol. 35, No. 4, pp.311–335.

Gammadigbe, V. (2021) 'Is regional trade integration a growth and convergence engine in Africa?', *IMF Working Papers*, Vol. 2021, No. 19), p.1 https://doi.org/10.5089/9781513567716.001.

Hamilton, K. and Clemens, M. (2011) 'Genuine savings rates in developing countries', *The World Bank Economic Review*, Vol. 13, No. 2, pp.333–356.

He, Q., Zhang, C. and Zhu, W. (2021) 'Does currency matter for regional trade integration?', *International Review of Economics & Finance*, Vol. 76, pp.1219-1234 http://doi.org/10.1016/j.iref.2019.11.010.

Im, K.S., Pesaran, M.H. and Shin, Y. (2003) 'Testing for unit roots in heterogeneous panels', *Journal of Econometrics*, Vol. 115, No. 1, pp.53–74 https://doi.org/10.1016/S0304-4076(03)00092-7.

Jimoh, S.O. and Chua, Y.S. (2021) 'Currency union and regional trade integrations in West Africa: the role of institutional quality', *Iranian Economic Review*, DOI: 10.22059/IER.2021.83928.

Korhonen, I. and Ledyaeva, S. (2010) 'Trade linkages and macroeconomic effects of the price of oil', *Energy Economics*, Vol. 32, No. 4, pp.848–856.

Krugman, P. (1980) 'Scale economies, product differentiation, and the pattern of trade', *American Economic Review*, Vol. 70, No. 5, pp.950–959.

Krugman, P. (1991) 'Increasing returns and economic geography', *Journal of Political Economy*, Vol. 99, No. 3, pp.483–499 https://doi.org/10.1086/261763.

Le Blanc, D. (2015) 'Towards integration at last? The sustainable development goals as a network of targets', *Sus. Dev.*, Vol. 23, No. 3, pp.176–187.

Levin, A., Lin, C.F. and Chu, C.S.J. (2002) 'Unit root tests in panel data: asymptotic and finite-sample properties', *Journal of Econometrics*, Vol. 108, No. 1, pp.1–24 https://doi.org/10.1016/S0304-4076(01)00098-7.

Melitz, M.J. (2003) 'The impact of trade on intra-industry reallocations and aggregate industry productivity', *Econometrica*, Vol. 71, No. 6, pp.1695–1725 https://doi.org/10.1111/1468-0262.00467.

Meo, M.S., Sabir, S.A., Arain, H. and Nazar, R. (2020) 'Water resources and tourism development in South Asia: an application of dynamic common correlated effect (DCCE) model', *Environmental Science and Pollution Research*, Vol. 27, No. 16, pp.19678–19687 https://doi.org/10.1007/s11356-020-08361-8.

Ogbuabor, J.E., Anthony-Orji, O.I., Ogbonna, O.E. and Orji, A. (2019) 'Regional integration and growth: new empirical evidence from WAEMU', *Progress in Development Studies*, Vol. 19, No. 2, pp.123–143 https://doi.org/10.1177/1464993418822883.

Oyejide, T.A. (2000) 'Policies for regional integration in Africa', *Economic Research Papers*, Vol. 62, African Development Bank.

Pesaran, M.H. (2021) 'General diagnostic tests for cross section dependence in panels', *Empirical Economics*, Vol. 60, No. 1, pp.13–50.

Phelps, E. (1961) 'The golden rule of accumulation: a fable for growthmen', in *American Economic Asso*., Vol. 51, No. 4, pp.638–643 https://doi.org/10.4324/9781315199818-34.

Rivera-Batiz, L.A. and Romer, P.M. (1991) 'Economic integration and endogenous growth', *The Quarterly Journal of Economics*, Vol. 106, No. 2, pp.531–555.

Shah, M.I., Abdulkareem, H.K.K., Daud, B. and Shujaat, I. (2022) 'The roles of energy, natural resources, agriculture, and regional integration on – CO_2 emissions in selected countries of ASEAN: does political constraint matter?', *Environmental Science and Pollution Research*, FAO https://doi.org/10.1007/s11356-022-23871-3.

Sheraz, M., Deyi, X., Ahmed, J., Ullah, S. and Ullah, A. (2021) 'Moderating the effect of globalization on financial development, energy consumption, human capital, and carbon emissions: evidence from G20 countries', *Environmental Science and Pollution Research*, Vol. 28, pp.35126–35144 https://doi.org/10.1007/s11356-021-13116-0/Published.

Solarin, S.A. and Bello, M.O. (2019) 'Interfuel substitution, biomass consumption, economic growth, and sustainable development: evidence from Brazil', *Journal of Cleaner Production*, Vol. 211, pp.1357–1366 https://doi.org/10.1016/j.jclepro.2018.11.268.

Solow, R.M. (1956) 'A contribution to the theory of economic growth', *The Quarterly Journal of Economics*, Vol. 70, No. 1, pp.65–94.

Stafford-Smith, M., Griggs, D., Gaffney, O., Ullah, F., Reyers, B., Kanie, N., Stigson, B., Shrivastava, P., Leach, M. and O'Connell, D. (2017) 'Integration: the key to implementing the Sustainable Development Goals', *Sustainability Science*, Vol. 12, No. 6, pp.911–919 https://doi.org/10.1007/s11625-016-0383-3.

Sustainable Development Solutions Network (2020) *Africa SDG Index and Dashboards Report 2020: Leave No One Behind to Achieve the SDGs in Africa* [online] http://www.pica-publishing.com.

Tumwebaze, H.K. and Ijjo, A.T. (2015) 'Regional economic integration and economic growth in the COMESA Region, 1980–2010', *African Development Review*, Vol. 27, No. 1, pp.67–77 https://doi.org/10.1111/1467-8268.12123.

Ullah, A., Chen, P., Ullah, S. and Hashmi, S.H. (2022b) 'The dynamic impact of financial, technological, and natural resources on sustainable development in Belt and Road countries', *Environmental Science and Pollution Research*, Vol. 29, pp.4616–4631 https://doi.org/10.1007/s11356-021-15900-4.

Ullah, A., Pinglu, C., Hashmi, S.H. and Ullah, S. (2021) 'Nexus of regional integration, socioeconomic determinants and sustainable development in Belt and Road Initiative countries', *PLoS One*, 7 July, Vol. 16 https://doi.org/10.1371/journal.pone.0254298.

Ullah, A., Pinglu, C., Ullah, S., Qaisar, Z.H. and Qian, N. (2022a) 'The dynamic nexus of e-government, and sustainable development: moderating role of multi-dimensional regional integration index in Belt and Road partner countries', *Technology in Society*, Vol. 68, p.101903 https://doi.org/10.1016/J.TECHSOC.2022.101903.

United Nations (UN) (2022) *One Year of Free Trading in Africa Calls for Celebration in Spite Teething Problems*, Africa Renewal [online] https://www.un.org/africarenewal/magazine/january-2022/one-year-free-trading-africa-calls-for-celebration-despite-teething-problems (accessed 20 March 2022).

World Bank (2023) *The World Bank in Western and Central Africa*, IBRD-IDA [online] https://www.worldbank.org/en/region/afr/western-and-central-africa (accessed 20 March 2022).

Yakubovskiy, S., Rodionova, T. and Kyfak, A. (2019) 'Inflow of foreign capital as a factor of the development of current accounts of the Eastern European countries', *J. Trans. St. Rev.*, Vol. 26, No. 2, pp.3–14, DOI: 10.14665/1614-4007-26-001.

Zaman, M., Pinglu, C., Hussain, S.I., Ullah, A. and Qian, N. (2021) 'Does regional integration matter for sustainable economic growth? Fostering the role of FDI, trade openness, IT exports, and capital formation in BRI countries', *Heliyon*, Vol. 7, No. 12 https://doi.org/10.1016/j.heliyon.2021.e08559.