7. THE RESOURCE-RICH COUNTRIES' BLUE ECONOMY: PROSPECTS FOR SUSTAINABLE ECONOMIC DEVELOPMENT APPENDIX

Ibrahim FAROUQ*[1]
Zunaidah SULONG[2]

Abstract

As climate change and fossil fuel dependency challenge global development, the blue economy offers a promising route to sustainability. This study examines how agriculture, forestry, and fishing value added (AF), aquaculture production (AP), and fishery production (FP) affect sustainable economic development (GS) in African oil-dependent countries from 1980 to 2023. Using the Panel Nonlinear ARDL model with Driscoll-Kraay standard errors, the analysis captures asymmetric effects. Positive shocks in AF, AP, and FP promote GS through improved food security, employment, and economic diversification. Surprisingly, negative shocks also show positive long-run effects, suggesting adaptive policy responses and institutional reforms play a mediating role. By including institutional quality—measured by control of corruption—the study confirms that good governance strengthens the impact of blue economy sectors on sustainability. Findings underscore the need for targeted investments and strong institutions to transform blue economy potential into long-term development outcomes.

Keywords: *blue economy, sustainable economic development, oil-dependent economies, Fisheries*

JEL Classification: C23, Q02, Q15

[1,2] *Faculty of Business and Management, University Sultan Zainal Abidin, Gong Badak Campus, Malaysia.*
** corresponding author, Email: ibrahimsambo@unisza.edu.my*

Appendix

Table 1: Descriptive Statistics Summary

Variables	Mean	Standard deviation	Skewness	Kurtosis	Jarque-Bera
GS_{it}	2589.100	1933.247	1.872	3.894	67.152* (0.000)
FP_{it}	1.44E+12	1.63E+11	0.528	1.517	5.482* (0.000)
AF_{it}	3226484	1791429	0.586	2.292	8.1904 (0.000)
AP_{it}	31.21386	20.41274	0.816	0.905	16.489 (0.000)
RE_{it}	11.85773	15.16281	-0.791	0.586	13.822 (0.000)
EI_{it}	14.83284	13.04195	0.863	2.150	35.288 (0.000)
EC_{it}	44.25381	382512.6	1.659	1.856	33.851 (0.000)

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

Table 2 Correlation Matrix and VIFs

Variables	GS_{it}	FP_{it}	AF_{it}	AP_{it}	RE_{it}	EI_{it}	EC_{it}	VIF
GS_{it}	1	0.15	0.32	0.27	0.16	0.20	0.18	1,21
FP_{it}	0.17	1	0.31	0.20	0.12	0.30	0.27	1.01
AF_{it}	0.25	0.32	1	0.09	0.19	0.32	0.36	1,32
AP_{it}	0.29	0.29	0.23	1	0.20	0.26	0.31	1.75
RE_{it}	0.13	0.06	0.11	0.07	1	0.28	0.18	1.63
EI_{it}	0.34	0.31	0.15	0.20	0.28	1	0.31	1.82
EC_{it}	0.14	0.26	0.20	0.30	0.19	0.20	1	1.96

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

Table 3 Cross-sectional Dependence Tests

	Leading African Economies	
Variables	Pesaran's CD test	Breush-Pagan (LM) test
$lnGS_{it}$	13.134*	67.816*
	(0.000)	(0.000)
$lnFP_{it}$	15.182*	81.704*
	(0.000)	(0.000)
$lnAF_{it}$	13.219*	56.835*
	(0.000)	(0.000)
$lnAP_{it}$	12.983*	38.934*
	(0.000)	(0.000)
$lnRE_{it}$	9.673*	85.981*
	(0.000)	(0.000)
$lnEI_{it}$	7.058*	90.863*
	(0.000)	(0.000)
$lnEC_{it}$	17.271	18.873*
	(0.000)	(0.000)

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

Table 4: Slope Homogeneity Tests

Group	Statistic
Delta	3.571*
Adjusted Delta	2.801**

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

Table 5 Symmetric and Asymmetric Unit Root Test

Variables	CIPS Test	OU Test	
		Intercept	Intercept and Trend
$lnGS$	-1.77	-0.511*	-0.239*
		(0.081)	(0.068)
$\Delta lnGS$	-3.712*	-5.035*	-5.082*
		(0.001)	(0.002)
$lnAF$	-2.057	-0.286	-1.861
		(0.796)	(0.572)
$\Delta lnAF$	-4.173*	-2.857*	-3.082*
		(0.001)	(0.001)
$lnAP$	-1.702	-1.832	-1.708
		(0.616)	(0.870)
$\Delta lnAP$	-4.304*	-4.208*	-3.696*
		(0.002)	(0.001)
$lnFP$	-0.938	-0.879	-2.307
		(0.151)	(0.686)
$\Delta lnFP$	-4.072*	-3.860*	-4.261*
		(0.002)	(0.001)
$lnEI$	-1.541	-0.314	-2.412
		(0.602)	(0.531)
$\Delta lnEI$	-4.352*	-4.510*	-4.751*
		(0.001)	(0.001)
$lnEC$	-1.214	-2.089	-1.899
		(0.139)	(0.892)
$\Delta lnEC$	-3.976*	-3.975*	-5.043*
		(0.001)	(0.001)
$lnRE$	-1.809	-1.247	-1.827
		(0.561)	(0.859)
$\Delta lnRE$	-5.153*	-4.789*	-4.601*
		(0.001)	(0.001)
	Critical Values		
1%	-3.87		
5%	-2.81		

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

Table 6 Summary Results of Heterogeneous Co-integration Tests

	with trend	without trend
Statistic	Value	Value
Gt	-5.024	-4.351
	(0.000)	(0.000)
Ga	-17.325	-16.171
	(0.080)	(0.000)
Pt	-7.328	-6.374
	(0.002)	(0.000)
Pa	-22.312	-20.431
	(0.000)	(0.000)

*Note: * Shows statistical significance at a 1 percent level, while ** signifies the 5 percent significance level. Source: WDI (2024); International Renewable Energy Agency (2024)*

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Pesaran and Yamagata (2008) Slope Homogeneity Test

H0: Slope coefficients are homogeneous
H1: Slope coefficients are heterogeneous

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          Test          |     Statistic     P-value
------------------------+-----------------------------
    Delta               |       3.571         0.000  *
    Adjusted Delta      |       2.801         0.005  **
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Notes:
*  Statistically significant at 1% level
** Statistically significant at 5% level
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Cointegration

Westerlund Error-Correction-Based Panel Cointegration Tests

H0: No cointegration

Test	With Trend	Without Trend
Gt	-5.024 (0.000)	-4.351 (0.000)
Ga	-17.325 (0.080)	-16.171 (0.000)
Pt	-7.328 (0.002)	-6.374 (0.000)
Pa	-22.312 (0.000)	-20.431 (0.000)

Estimation results

Linear regression — Number of obs = 220
Method: Driscoll-Kraay standard errors — Number of groups = 5
Group variable: country — F(7, 44) = 12.57
Prob > F = 0.0000
R-squared = 0.7500 — Root MSE = 0.0573

lnEF_it	Coef.	Drisc/Kraay Std. Err.	t	P>|t|
lnFP_it	0.036	0.014	2.57	0.006 **
lnAF_it	0.052	0.019	2.74	0.003 *
lnAP_it	0.030	0.012	2.50	0.028 **
lnRE_it	0.041	0.017	2.41	0.019 **
lnEI_it	-0.051	0.015	-3.40	0.002 *
lnEC_it	0.035	0.011	3.18	0.001 *
lnIQ_it	0.048	0.016	3.00	0.003 *
Country FE	Yes			
Year FE	Yes			

* p<0.01, ** p<0.05

Linear regression — Number of obs = 220
Method: Driscoll-Kraay standard errors — Number of groups = 5
Group variable: country — F(10, 44) = 8.06
Prob > F = 0.0000
R-squared = 0.7700 — Root MSE = 0.7060

lnEF_it	Coef.	Drisc/Kraay Std. Err.	t	P>|t|
lnFP_it	0.030	0.013	2.31	0.022
lnAF_it	0.045	0.018	2.50	0.014
lnAP_it	0.028	0.011	2.55	0.012
lnRE_it	0.039	0.016	2.44	0.015
lnEI_it	-0.049	0.015	-3.27	0.000
lnEC_it	0.034	0.010	3.40	0.000
lnIQ_it	0.041	0.017	2.41	0.016
lnFP*IQ_it	0.019	0.007	2.71	0.008
lnAF*IQ_it	0.025	0.009	2.78	0.006
lnAP*IQ_it	0.017	0.006	2.83	0.005
Country FE	Yes			
Year FE	Yes			

Panel NARDL estimation — Number of groups = 5
Long-run and short-run asymmetries included — Time periods = 44
Method: Pooled Mean Group — Obs per group = balanced

Variable	Coef.	Std. Err.	t	P>|t|
Long-run results				
lnFP⁺	0.426		[2.91]	0.004
lnFP⁻	0.481		[3.87]	0.000
lnAF⁺	0.037		[2.19]	0.012
lnAF⁻	0.106		[2.53]	0.006
lnAP⁺	0.041		[3.44]	0.000
lnAP⁻	0.022		[2.35]	0.021
lnRE	0.654		[3.51]	0.000
lnEI	-0.683		[4.28]	0.000
lnEC	0.017		[4.01]	0.000
lnIQ	0.096		[2.18]	0.031

Short-run results

ECM(-1)	-0.231	[-3.11]	0.000
ΔlnFP⁺	0.398	[3.77]	0.000
ΔlnFP⁻	0.328	[3.06]	0.000
ΔlnAF⁺	0.128	[3.43]	0.000
ΔlnAF⁻	0.297	[2.72]	0.007
ΔlnAP⁺	0.142	[2.85]	0.000
ΔlnAP⁻	0.693	[3.49]	0.000
ΔlnRE	0.591	[2.72]	0.000
ΔlnEI	-0.311	[4.97]	0.000
ΔlnEC	0.362	[2.89]	0.004
ΔlnIQ	0.063	[2.15]	0.033

Country fixed effects: Yes (F(4, ∞) = 6.74, p = 0.000)

Time fixed effects: Yes (F(33, ∞) = 4.17, p = 0.000)

Notes: * p<0.01; ** p<0.05