

Towards blue economic growth across African countries

التوجه نحو نمو اقتصادي أزرق في البلدان الإفريقية

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Abstract :

This article explores the impact of the blue economy on economic growth across eleven African countries, focusing on fisheries and aquaculture production during the period 1992-2022. A feasible GLS model was estimated in order to take into account for cross section dependence and autocorrelation problems. The findings reveal that fisheries and aquaculture significantly contribute to economic growth. Trade has a positive impact as well, while inflation negatively affect growth. Despite their critical role in food security, job creation, and economic stability, fisheries and aquaculture remain underdeveloped and underfunded, hindered by challenges such as ecosystem degradation and water pollution.

Key words: blue economy- aquaculture- Africa - feasible GLS model

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1. Introduction :

With growing global awareness of environmental sustainability, the concept of the blue economy has emerged as a strategic approach to reconciling economic development with marine ecosystem preservation. The blue economy serves as a key framework for sustainable development, especially in coastal and island nations, emphasizing the sustainable use of ocean resources to promote both economic growth and environmental health. According to the (World Bank 2017) the blue economy encompasses diverse activities beyond traditional sectors like fisheries and shipping, including marine biotechnology, renewable energy, and eco-tourism. The European Commission defines the blue economy as “all economic activity associated with oceans, seas, and coasts. It englobes a large range of connection between establishment and emerging sectors” (European Union 2018).

Given that oceans, seas and coastal areas cover over two thirds of the Earth's surface, their ecological significance is immense. These ecosystems provide food for millions of species, more than one billion people and play a critical role in mitigating climate change (Parletta 2019). Despite the importance of the oceans for all countries, only 7% of earth's seas and oceans have been explored (Toropova et al. 2010). This stark reality highlights the need for an integrated approach that connects economic growth with ecosystem preservation. By focusing on sustainable fishing and responsible aquaculture, countries can improve local economies while safeguarding marine biodiversity, addressing issues like poverty alleviation and food security.

The growing attention to the blue economy from policymakers and stakeholders underscores its significance in achieving the United Nations' Sustainable Development Goals (SDGs), particularly Goal 14, which focuses on the conservation and sustainable use of oceans and marine resources. Engaging local communities and fostering cross-sector collaboration are essential for ensuring equitable benefits and the long-term sustainability of marine resources. The sustainable use of these resources will have a positive implications for economy and environment (Singh 2019).

In this context, African countries have begun to recognize the immense potential of the blue economy as a driver of sustainable

economic growth. The blue economy refers to the sustainable use of ocean and freshwater resources for economic development, encompassing sectors such as fisheries, aquaculture, marine tourism, and renewable ocean energy. With vast coastlines and rich aquatic resources, Africa stands to benefit significantly from a strategic focus on this emerging economic paradigm. The relationship between the blue economy and economic growth in African nations is multifaceted. Sustainable management of marine and freshwater resource can enhance food security, create employment opportunities, and stimulate innovation across various sectors. For instance, responsible fisheries management can lead to the recovery of fish stocks, directly benefiting local communities reliant on fishing for their livelihoods. Additionally, the burgeoning marine tourism sector presents an opportunity for economic diversification, attracting international visitors while promoting conservation and community engagement. Moreover, the growth of marine tourism presents a unique opportunity for African countries to attract international visitors, generate revenue, and promote conservation efforts.

However, realizing the full potential of the blue economy requires addressing governance challenges, strengthening regulatory frameworks, and fostering partnerships among governments, private sector actors, and local communities. This research investigates the impact of the blue economy on economic growth in African countries. It's about highlighting how African countries can profit from blue economy. For any economy, the primary indicator growth is its gross domestic product (GDP) (Mankiw 2018). GDP is defined as the total value of all goods and services produced by residents, plus product taxes (OECD 2022). GDP per capita provides insight into how much is being spent on each person in a particular country and is used to calculate the performance of that country's economy (OECD 2017).

For instance, South Africa, as the most industrialized country has a relatively high GDP per capita, reflecting a more developed economy. While Seychelles, despite its small population, leads with the highest figure, driven by tourism and fisheries. Countries like Namibia and Tunisia show moderate levels of economic development, yet still face challenges such as unemployment and regional disparities. Conversely, nations like Sudan, Cameroon, and

Kenya struggle with lower GDP per capita, indicating significant poverty and economic instability. Overall, this diversity highlights the varying stages of economic development across the continent, where some countries are on a path of growth while others require substantial reforms and investment to enhance living standards (see table 1).

Table 1 :GDP per capita across African countries in 2022

Countries	GDP PER CAPITA (USD)
Cameron	1441,79
Egypt	4088,89
Ghana	2046
Ivory Coast	2399.69
Kenya	1754.58
Morocco	3300.79
Namibia	4394.39
Senegal	1460.49
Seychelles	16188.78
South Africa	6022.42
Tunisia	3917.63

Source: world Bank indicators 2022

By prioritizing the blue economy, African nations can embark on a path toward sustainable development that ensures prosperity for current and future generations. This research seeks to answer a crucial question:**How does the blue economy contribute to the economic growth of eleven African countries?**The study is organized as follows:Section 2 provides a rigorous literature review of the blue economy and economic growth.Section 3 provides a detailed overview of study’s methodology. Section 4 discusses the results and analysis. Section 5 concludes with key findings and policy recommendations.

2. Literature Review:

The concept of the blue economy has gained prominence as a sustainable development model that emphasizes the potential of aquatic resources to drive economic growth while safeguarding environmental health. The World Bank (2017)defines the blue economy as the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs, while preserving the health

of ocean ecosystems. This definition highlights the dual objectives of economic development and environmental sustainability, which are critical for countries with extensive marine and freshwater resources. In addition, the ecosystems marine provides both directly and indirectly benefits economies and services for human well-being (Roberts et al. 2021) .

Several researchers have documented the economic potential of marine resources in Africa. According to a report by the Food and Agriculture Organization (FAO 2016) fisheries and aquaculture contribute significantly to the GDP of many African nations, providing livelihoods for millions. The importance of sustainable fisheries management is emphasized in the literature as a key strategy to improve food security and local economies. Sustainable fishing practices not only help maintain fish stocks but also contribute to community resilience in the face of economic fluctuations.

According to Holling (1973) the resilience concept refers to the human systems, the capability of ecosystems, human systems and management systems to absorb unexpected shocks and perturbations without collapsing self-destructing or otherwise entering an intrinsically undesirable.

The relationship between the blue economy and economic growth is complex, involving various economic variables such as total fishery production, aquaculture output. This review synthesizes empirical studies that explore these relationships, particularly in the context of developing countries.

Total fishery production has been shown to significantly contribute to economic growth, especially in coastal nations. According to (FAO 2007) fish contribute more than 60% of the world supply of protein, especially in the developing countries. Rehman et al. (2019) used an autoregressive distributed lag (ARDL) to examine the impact of aquaculture and fishery production on GDP in Pakistan. They found a positive correlation between increases in fishery output and economic growth. This relationship is attributed to the provision of livelihoods, export revenues, and food security. Eyuboglu and Akmermer (2023) analyzed the impact of fisheries production on

economic growth by employing the ARDL model from 1990-2019. The results revealed a positive relationship between fisheries production and economic growth in the long-term in Turkish.

In contrast, a study done by Oyakhilomen and Grace Zibah(2013) found that fishery production was insignificant in influencing economic growth in Nigeria . This was attributed to the low domestic fishery output of Nigeria and the considerable loss of foreign exchange earnings due to the growing importation of fish to bridge demand-supply gap.

Aquaculture has emerged as a crucial component of the blue economy, offering an alternative source of protein and income. As the fastest-growing food-producing industry globally, it has experienced an annual growth rate of 9.58% from 1990 to 2018, reaching 114.5 million tons of live weight in 2018 with a total farm-gate sale value of \$263.6 billion (FAO 2020).

According to Bostock et al. (2016), aquaculture production significantly contributes to economic growth by increasing food availability and generating employment. Their analysis suggests that countries investing in sustainable aquaculture practices experience higher GDP growth rates. Furthermore, aquaculture's capacity to relieve pressure on wild fish stocks contributes to long-term sustainability; thereby enhancing overall economic resilience (Troell et al. 2014). Aquaculture is increasingly recognized as a critical driver of economic growth. Recent research by (FAO 2022) highlights that global aquaculture production has surpassed wild catch, making it essential for food security and economic stability.

3. Research methodology

3.1. Data

In our study, we used annual data collected from world development indicators published by the World Bank. We create a panel consisting of 11 countries (South Africa, Morocco, Tunisia, Kenya, Ivory Coast, Seychelles, Namibia, Egypt, Senegal, Cameroon, Ghana) from **1992 and 2022**.

3.2. Econometric model:

The functional form of our model can be expressed in the following way:

$$Growth = \mathcal{F}(Capital, blue\ economy, Z)$$

Here blue economy depend on total fish production (TFP) and aquaculture production (AP). Z is a vector of control variables such as inflation and trade.

$$blue\ economy = \mathcal{F}(TFP, AP)$$

And

$$Z = \mathcal{F}(inflation, trade)$$

The econometric model can be written as follows:

$$\ln(GW_{i,t}) = \alpha_{i,t} + \beta_1 * Capital_{i,t} + \beta_2 * \ln(TFP_{i,t}) + \beta_3 * \ln(AP)_{i,t} + \beta_3 * INF_{i,t} + \beta_3 * trade_{i,t} + \varepsilon_{i,t}$$

3.3. Variables:

GW: the dependent variable of our model is GDP per capita measured in constant Dollar 2015.

Capital: the gross fixed capital formation as a percentage of GDP is used to analyze the effect of capital growth on GDP in African countries.

Inflation rate (INF): is measured using consumer price index as a percentage. The inflation rate reflects the changes of purchasing power of money.

Trade: is the ratio of the sum of exports and imports of goods and services to GDP.

Total fishery production (TFP): is the volume of aquatic species harvested by a country for commercial, industrial, recreational and subsistence purposes. It is expressed in metric tons.

Aquaculture production (AP): refers to the farming of aquatic life for consumption, including fish, mollusks and aquatic plants. It is expressed in metric tons.

4. Empirical findings:

4.1. Descriptive statistics

Table 1 highlights descriptive analysis data. The variability of the variables, which is measured by the standard deviation, differs greatly from one another. For instance, we used skewness to assess the concentration and to determine the characteristics of variables at the minimum and the maximum values. In the current study, all variables except $\ln(\text{TFP})$ manifest positive skewness values indicating that all distributions are asymmetric. They are extended towards the right. The Kurtosis values of all variables suggest that their distribution has heavier tails than a normal distribution.

Tableau 1 : Descriptive statistics of the variables

Variable	Obs	Mean	Standard. Deviation.	Min	Max	Skewness	Kurtosis
$\ln(\text{GDP})$	370	7.77311	0.7333188	6.776111	9.877228	0.8887164	3.121727
$\ln(\text{AP})$	361	7.628945	2.555589	-2.302585	14.31139	0 .1810339	4.763849
TI	370	10.84499	25.82442	-3.206555	359.093	8.434173	98.31886
CAPITAL	372	20.90893	6.170292	2.178264	45.59344	0.6080171	4.261457
$\ln(\text{TFP})$	370	11.67422	2.867127	2.717756	14.52797	-2.32167	7.561681
TRADE	372	52.6401	25.45632	12.83408	154.8595	1.176139	4.366025

Source: Authors' compilation and values obtain from STATA.

4.2. Correlation analysis

For hall sample, the correlation matrix reveals the potential for multicollinearity among explanatory variables. It was used to assess both the strengthen and direction of relationship between variables. The correlation matrix results indicate that there is no multicollinearity among variables.

Tableau 2 : correlation matrix

	$\ln(\text{AP})$	$\ln(\text{TFP})$	TI	TRADE	CAPITAL
$\ln(\text{AP})$	1				
$\ln(\text{TFP})$	0.1486	1			
TI	0.0516	-0.007	1		
TRADE	-0.2931	0.0259	-0.1101	1	
CAPITAL	-0.1675	0.1735	-0.3488	0.4117	1

Source: Authors' compilation and values obtain from STATA.

4.3. Gauss-Markov assumptions

Hallin (2014) provide the Gauss Markov assumptions under which the application of least square method grants the best unbiased estimators for linear model. This method gives a maximum likelihood solution that is more robust than alternative technique (Alharthi and Hanif 2020).

For a panel data analysis, the major estimation problems are the data normality, serial correlation and heteroscedasticity. Table 3 shows the results of normality test and heteroscedasticity test. The results found indicate that several Gauss-Markov assumptions are breached. Consequently, fixed-effect and random-effect models were executed. The fixed effect model takes account for variations in intercepts between countries (Kelejian and Piras 2017). It accommodates heterogeneity among them (Alharthi and Hanif 2020). Unlike fixed effect, random effect model allows for variability and differences between countries.

To determine whether a fixed-effect model or a random-effect model is more appropriate, a Hausman test was conducted.

Table 3: tests of Gauss-Markov assumptions

Diagnostic test	Statistics	Probability	Conclusion
Jarque-Bera normality test Chi2	0.452	1.588	Normality is absent
Breusch-Pagan/Cook-Weisberg test for Heteroscedasticity	18.8	0.000	Heteroscedasticity is present

Source: Authors' compilation and values obtain from STATA.

Table 4 : results of diagnostics tests

Diagnostic test	Statistics and probabilities	Conclusion
Hausman test H0: difference in coefficients not systematic	chi2(5) = 0.13 Pr=0.9997	The random effect model is more efficient
Breusch and Pagan LM Test of independence H0: There exists cross-sectional dependence	chi2(66) = 374.610 Pr = 0.0000	Cross-sectional dependence is present
Wooldridge test for autocorrelation H0: No order autocorreclation	F(1,11)=43.862 Pr=0.000	Serial correlation is present

Source: Authors' compilation and values obtain from STATA.

Table 4 indicates that the random effect model is more appropriate to explain the outcomes since the p-value of the Hausman test exceeds 0.05. To investigate the reliability of the results, it is crucial to test for serial correlation and cross-sectional dependence. Thus, we run Breuch and Pagan LM test to assess the presence of the cross-sectional dependence, while we use Wooldridge test to discuss whether serial correlation was resolved. The results show evidence of both cross-sectional dependence and autocorrelation.

With the aim of including heteroscedasticity and cross-section dependence, Parks (1967) developed a feasible generalized least square method to estimate panel models. This estimator can be applied when the number of time periods exceeds the number of cross-sections (Reed and Ye 2011).

5. Results and discussion

The estimation results are presented in Table 5. The FGLS model reports a Wald Chi-squared statistic of approximately 99.32 ($p = 0.000$) confirming the overall statistical significance of the model. All variables are significant except for Capital. The results emphasize that fisheries production stimulates the economic growth. Indeed, a 1% increase in fisheries production leads to 0.024% raise in GDP per capita. As a vital contributor to national income, fisheries production also plays an essential part in ensuring food security and supporting livelihoods in Africa (Asche et al. 2021).

Furthermore, aquaculture appears to be a contributor to economic growth. A 1% increase in aquaculture accelerates economic growth by 0.03%. Kaunda and Chimatiro (2015) explain that aquaculture in African countries remains largely underdeveloped, dominated by small-scale farmers aiming for food security rather than economic growth. More importantly, many African countries have undertaken efforts to develop aquaculture. As a result, aquaculture production has experienced a remarkable expansion over the past two decades (Adeleke et al. 2020). In fact, with an annual growth of 8.6%, aquaculture has emerged as the fastest-growing sector in global food production (Oyebola and Olatunde 2019). In this context, Chan et al. (2021) predict, under a business-as-usual scenario, that Africa's fish sector will generate 20.7 million employments by 2030 and 21.6 million employments by 2050.

The results show also that trade has a positive effect on economic growth. This finding is in line with the achievements of Bunje, Abendin, and Wang (2022) who found a positive relationship between trade and economic growth for the case of African countries. Our results diverge from that of Farahane and Heshmati(2020) in that it revealed a negative relationship between trade and economic growth. Zahonogo(2016) in contrast, demonstrated that there is a nonlinear relationship between trade and economic growth.

Moreover, our findings indicate a negative relationship between inflation and economic growth, which is in line with the findings of Adu-Gyamfi et al. (2020) and Bittencourt, Van Eyden, and Seleteng(2015). In particular, Bittencourt, Van Eyden, and Seleteng(2015)contended that inflation has exerted a harmful effect on growth in fifteen sub-Saharan African countries during the period 1980-2009. Similarly, Adu-Gyamfi et al. (2020) founded that inflation had a detrimental effect on growth in nine western African countries for the period 1998-2017.Although, several studies conducted across African regions including those by (Olowofeso and Adeleke 2022),(Iriagbonse-Alikor and Otonne 2022) and (Ndoricimpa 2017), suggest the presence of a threshold effect between inflation and growth. These studies indicate that inflation positively influences the economic growth up to a threshold beyond which its effect becomes negative.

Table 5: regression results

Variables	Coefficients	Standard error
Ln(TFP)	0.02802*	0.00637
Ln(AP)	0.03262*	0.00809
TI	-0.00261*	0.00096
TRADE	0.00521*	0.00065
Capital	0.000549	0.00195
Constant	6.9427*	0.10188
Wald Chi2(5)	112.56	
Pr>Chi2	0.000	
NB of obs	330	

*P <0.01

Source: Authors' compilation and values obtain from STATA.

6. Conclusion

This study aims to investigate the impact of the blue economy on economic growth in eleven African countries from 1992 to 2022, with a particular focus on fisheries and aquaculture production. In order to answer to this question, a feasible GLS model was estimated. The research findings reveal that fisheries and aquaculture production contribute significantly to the economic growth and play a crucial role in driving development. Furthermore, trade positively affects economic growth while inflation has a negative effect. However, Capital was not significant.

Despite that fisheries and aquaculture sectors play a crucial role in jobs creation, economic growth and food security, they have often been underestimated. Therefore, this lead to insufficient investment to foster growth sector and drive the sustainable transformation required to meet the increasing demand for fish. On the other hand, the alarming status of the environment constitutes a threat to the development of the fisheries and aquaculture sectors. In fact, the destruction of ecosystems, water pollution and acidification are leading to the extinction of numerous species.

In order to promise a better future for their populations, governments should intensify conservation efforts, reduce pressure on natural resources, and promote more sustainable and innovative farming practices. In addition, national governments must offer financial and technical supports to addressing overfishing and encourage expanding the cultivation of aquatic species well suited to their climates. By investing in clean technology and advancing climate-smart aquaculture, they can boost economic growth and protect the environment simultaneously.

The present study faces shortcomings that should be handled in future research. It is limited by the availability of data and the small sample size of just 11 African countries. The future research should expand the scope to include more countries. Moreover, it is pertinent to include other variables such as marine transport and marine tourism.

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