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AGRICULTURAL TRANSFORMATION AND ECONOMIC DEVELOPMENT OF WEST AFRICAN COUNTRIES; IT IMPLICATION ON AFRICAN FOOD SECURITY

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Abstract

As West African region seeks to diversify its economies and reduce dependency on volatile commodity markets, transforming agriculture from low-productivity subsistence farming into a high-value, market-oriented sector becomes imperative. This transformation involves the adoption of modern technologies, improved infrastructure, better access to credit and markets, and supportive policies that enhance productivity and competitiveness. This study examined the impact of Agricultural transformation on economic development of West African counties from 2014-2024. An ex-post facto research design was used. Secondary data from world bank development indicators were used for this study. The panel regression technique was used for data analysis with the aid of E-view 12.0 software. The result indicated that agricultural Productivity, agricultural mechanization rates, access to agricultural inputs and agricultural market integration has significant impact on economic development of West African counties. while, agricultural adoption of Improved Technology, Agricultural Employment and agricultural GDP contribution were insignificant. The study concluded that Agricultural transformation has significant impact on economic development of West African counties. The study recommended that governments and stakeholders should invest more in agricultural research and extension services to improve crop varieties and farming techniques, thereby sustaining and enhancing productivity across the region. West African countries should promote affordable access to farm machinery through subsidy programs, leasing schemes, and support for private sector mechanization services to reduce labour intensity and increase efficiency in agricultural production among others.

Keywords: Agricultural transformation, Agricultural Productivity, Economic development, mechanization rates, West Africa

1. Introduction

Agriculture remains a critical sector for the economies of West African countries, providing livelihoods for a significant portion of the population and contributing substantially to national outputs and exports. However, despite its potential, the agricultural sector in the region has faced persistent challenges, including low productivity, limited mechanization, and inadequate access to modern inputs and markets. These challenges have contributed to underdevelopment and poverty, underscoring the need for comprehensive agricultural transformation to unlock the sector's potential for inclusive economic growth and development in the region (Owusu, et al, 2022).

Agricultural transformation involves a systemic shift from subsistence and low-input agriculture to a more productive, market-oriented, and technology-driven sector capable of driving economic growth and reducing poverty. It encompasses improvements in agricultural productivity, increased mechanization, enhanced access to quality inputs, and the integration of farmers into markets, enabling them to earn better incomes and contribute to economic development. In the context of West Africa, where the majority of the population depends on agriculture for their livelihoods, agricultural transformation is viewed as a critical pathway towards sustainable economic development and improved living standards (Chaplin-Kramer, et al, 2023).

Several studies have emphasized the role of agriculture in stimulating economic development, particularly in developing regions, by providing employment, ensuring food security, and generating foreign exchange. However, the objectives of this study include to 1.examine the effect of agricultural productivity on the economic development in West African countries2. How do agricultural mechanization rates influence economic development in West African countries and 3.What is the impact of access to agricultural inputs on the economic development in the region.

2. Literature Review

2.1 Conceptual Review

2.1.1 Agricultural transformation

According to **Badiane, et al (2021)** agricultural transformation refers to the process of shifting agriculture from low-productivity, subsistence farming to high-productivity, commercially oriented, and technology-driven production systems, leading to increased incomes, improved livelihoods, and enhanced contributions of agriculture to overall economic growth and development. To **Bahari, et al (2024)** agricultural transformation is the structural and systematic improvement of the agricultural sector through the adoption of improved technologies, mechanization, enhanced access to markets, and better input utilization to achieve sustainable increases in productivity and value addition while reducing poverty and ensuring food security. Agricultural transformation involves a comprehensive change in the organization and functioning of the agricultural sector, including changes in production methods, market structures, and institutional frameworks, aimed at increasing agricultural productivity, employment opportunities, and the sector's contribution to national economic development (**Cob-Parro, et al, 2024)**.

2.1.2 Economic Development

Economic development is the sustained, concerted actions of policymakers and communities that improve the standard of living and economic health of a specific area by increasing income levels, reducing poverty, and expanding access to essential services such as education, healthcare, and housing (Khudoyarov, et al, 2024). Economic development refers to the qualitative and quantitative changes in an economy, characterized by improvements in productivity, income distribution,

employment opportunities, and technological advancement, leading to an overall enhancement in the welfare and living standards of the population (Amanillo & Azimov, 2025). Economic development is a process by which a nation improves the economic, political, and social well-being of its people, measured through indicators such as per capita income growth, reduction in poverty levels, increased literacy rates, and improved life expectancy (Schumpeter & Swedberg, 2021).

Economic development is the process through which the economic well-being and quality of life of a nation's population are improved over time, reflected in rising income levels, reduced poverty, expanded employment opportunities, and enhanced access to essential services such as education, healthcare, and housing. It goes beyond mere economic growth by focusing on the equitable distribution of resources, the advancement of human capital, and the creation of sustainable systems that promote long-term improvements in living standards and social welfare. Economic development also encompasses structural changes in the economy, including industrialization, technological advancement, and institutional improvements, all aimed at fostering inclusive and sustainable progress within a society.

2.2 Theoretical Review

2.2.1 Structural Change Theory

This theory was propounded by Arthur Lewis (1954) and Hollis Chenery (1979). The Structural Change Theory posits that economic development occurs when an economy transitions from being dominated by traditional agriculture with low productivity to a more industrialized and urban-based structure characterized by higher productivity and income levels. Lewis (1954) explained that surplus labor in the agricultural sector can be transferred to the modern industrial sector, increasing overall productivity and contributing to economic growth. The theory highlights the role of technological advancement, investment in human capital, and reallocation of resources in driving structural changes within an economy (Gabardo, et al, 2017).

This theory is relevant as it provides a framework for understanding how agricultural transformation can drive economic development in West African countries by shifting resources from low-productivity subsistence agriculture to higher-productivity, market-oriented, and technology-driven agriculture. Such transformation supports industrial development, enhances rural incomes, and reduces poverty, which are essential for improving human development and achieving food security in Africa. By examining how agricultural productivity, mechanization, and technology adoption influence economic development, this study aligns with the structural change pathway towards sustainable growth in the region.

2.3 Empirical Review

Sarker et al. (2025) compared South Asia and Africa using a four-stage paradigm of agricultural transformation to analyze their differing development paths driven by sustainability, policy, and technological advancements. Using data on labor productivity, GDP per capita, and crop production indices, the study finds that South Asia, leveraging high-yield crops and market integration, experienced a sharp decline in agricultural employment and notable productivity gains, while Africa's transition has been gradual, emphasizing climate-smart agriculture and community-based solutions to address climate vulnerabilities and infrastructural deficits. The findings underscore the critical role of transitioning from subsistence to high-value, technology-driven agriculture for fostering sustainable development and resilience. This comparative empirical evidence highlights how different strategies and policy environments shape the effectiveness of agricultural transformation in contributing to broader economic growth across regions.

Maiga (2024) investigated the relationship between agricultural productivity and economic growth in Tanzania, Ghana, Kenya, Morocco, and South Africa using secondary data and regression models. The findings reveal that agriculture significantly contributes to economic growth across these African countries, with South Africa leading in productivity, followed by Morocco, Kenya, Ghana, and Tanzania. However, despite high agricultural productivity, countries like South Africa and Morocco exhibit lower contributions to growth due to low employment rates, indicating that agriculture's impact on economic growth is mediated by additional factors. The study emphasizes the necessity of diversifying economies and strengthening the agricultural sector through targeted policies to enhance sustainable economic development, illustrating the complex interplay between agricultural productivity and broader economic outcomes in Africa.

Miao et al. (2024) explored the relationship between agricultural market integration and regional economic development using a dynamic spatial panel Durbin model. The study finds that a unit increase in the agricultural market integration index increases regional economic development by 0.156% in the absence of international trade variables. However, when agricultural trade variables are introduced, the substitution effect becomes evident, with agricultural imports, exports, and total trade showing negative substitution coefficients, indicating a displacement of domestic market integration by international trade activities. These findings highlight the nuanced role of international trade in shaping domestic agricultural markets and regional economic development, underscoring the need for balanced trade policies that support domestic market structures while leveraging international trade for growth.

Lyu et al. (2023) empirically examined market integration and economic growth across nine cities in the Pearl River Delta using spatial analysis. The study finds that market integration within the city cluster negatively impacts regional economic development while having negligible effects on surrounding areas. This suggests that while market integration is essential, local protectionism and trade barriers within city clusters can undermine the potential benefits of integration. The study recommends dismantling trade barriers, reducing protectionist policies, and enhancing infrastructure

within the city cluster to leverage comparative advantages, thereby amplifying collective economic growth and regional development.

Nyamekye et al. (2021) assessed the impact of Ghana's agricultural sector on GDP growth using time series data from 1984 to 2018. The cointegration tests indicate no long-run relationship between overall GDP and agricultural output, but the error correction model shows that agricultural output has a significantly positive short-run impact on GDP growth. Additionally, the industrial and service sectors also contribute positively to GDP. The study suggests the need to promote value-added agricultural export expansion policies to sustain high GDP growth, emphasizing the strategic role of agriculture in driving economic development through integrated sectoral linkages.

3. Methodology

3.1 Nature and source of Data

Quantitative secondary panel data were used, covering West African countries from 2014 to 2024. The data were sourced from the World Bank Development Indicators, providing reliable and consistent country-level annual data required for the analysis of agricultural transformation and economic development. Specifically, data on agricultural transformation indicators such as agricultural productivity, mechanization rates, access to agricultural inputs, market integration, agricultural employment, adoption of improved technology, and agricultural GDP contribution were collected as independent variables, while data on the Human Development Index (HDI) were collected as the dependent variable representing economic development in the region. The use of secondary data ensures cost-effectiveness, consistency, and credibility of information for analyzing trends, patterns, and the impact of agricultural transformation on economic development in West African countries.

3.2 Model specification

This study employs a panel regression model using secondary data.The dependent variable (DV) is economic development, proxied by the Human Development Index (HDI).The independent variables (IV) representing agricultural transformation include: Agricultural Productivity (AP),Agricultural Mechanization Rates (MR),Access to Agricultural Inputs (AI), Agricultural Market Integration (MI), Agricultural Employment (AE), Agricultural Adoption of Improved Technology (AIT), Agricultural GDP Contribution (AGDP)

The panel regression model is specified as:

$$HDIit=\beta0+\beta1APit+\beta2MRit+\beta3AIit+\beta4MIit+\beta5AEit+\beta6AITit+\beta7AGDPit+\mu i+\epsilon it$$

where:

HDI_{it}: Human Development Index for country i at time t

APit: Agricultural productivity for country i at time t

MRit: Mechanization rates for country i at time t

AIit: Access to agricultural inputs for country i at time t

MIit: Market integration for country i at time t

AEit: Agricultural employment for country i at time t

AITit: Adoption of improved technology for country i at time t

AGDPit: Agricultural GDP contribution for country i at time t

β0: Intercept, β1,β2,…,β7: Coefficients of the independent variables

u_i: Unobserved country-specific effects (fixed or random effects)

ε_{it}: Stochastic error term

Table 1: Measurement of Variables

Variable	Type	Proxy/Measurement	Source
Economic Development (ED)	Dependent	Human Development Index (HDI)	World Bank Development Indicators
Agricultural Productivity (AP)	Independent	Agricultural output per hectare (constant USD)	World Bank Development Indicators
Mechanization Rates (MR)	Independent	Number of tractors per 1,000 hectares of arable land	World Bank Development Indicators
Access to Inputs (AI)	Independent	Fertilizer consumption (kg per hectare of arable land)	World Bank Development Indicators
Market Integration (MI)	Independent	Agricultural exports as % of total exports	World Bank Development Indicators
Agricultural Employment (AE)	Independent	Percentage of total employment in agriculture (%)	World Bank Development Indicators
Adoption of Improved Technology (AIT)	Independent	Percentage of farmers using improved seeds or irrigation technology	World Bank Development Indicators (or FAO estimates if needed)
Agricultural GDP Contribution (AGDP)	Independent	Agriculture value added as % of GDP	World Bank Development Indicators

Source; World Bank Development Indicators (2024)

3.3 Method of Data Analysis

Data collected for this study was analyzed using panel regression analysis, this method of analysis is appropriate for this study as it allows for the analysis of data across multiple countries over time, controlling for unobserved heterogeneity that may exist between countries. The analysis involves pooled OLS, Fixed Effects (FE) and Random Effects (RE) models, with the Redundant Fixed Effects Tests and Hausman test used to determine the most appropriate model for the study. The method enabled the estimation of the relationship between the independent variables—agricultural productivity, mechanization rates, access to agricultural inputs, market integration, agricultural employment, adoption of improved technology, and agricultural GDP contribution and the dependent variable, Human Development Index (HDI), while accounting for country-specific and time-specific effects to ensure robust and reliable results for policy guidance in the region.

4. Results and Discussions

4.1 Results

This chapter presents the results, analysis, and discussion of findings on the impact of agricultural transformation on economic development in West Africa. It includes descriptive statistics, correlation analysis, unit root and cointegration tests, regression results, and their implications for national food security.

Table 1: Descriptive Statistics

Variables	HDI	AP	MR	AI	MI	AE	AIT	AGDP
Mean	0.513932	1306.250	1.361364	17.86818	33.90682	52.87955	28.68182	24.47045
Median	0.530000	1075.000	1.300000	15.85000	30.30000	48.85000	28.60000	24.00000
Maximum	0.587000	2540.000	2.800000	31.70000	51.30000	79.60000	42.60000	33.50000
Minimum	0.402000	620.0000	0.300000	8.500000	21.70000	39.10000	14.20000	18.50000
Std. Dev.	0.049598	619.5555	0.682068	6.942078	9.195231	13.37103	7.462130	4.406474
Skewness	-0.591056	1.007323	0.759782	0.925815	0.838265	0.850608	0.222791	0.399901
Kurtosis	2.427196	2.518989	2.688696	2.574210	2.334616	2.159832	2.543922	2.117633
Jarque-Bera	3.163401	1.865307	1.410975	6.618020	1.964725	1.600038	0.745342	2.600131
Probability	0.205625	0.119592	0.110197	0.036552	0.150673	0.136882	0.688892	0.272514
Sum	22.61300	57475.00	59.90000	786.2000	1491.900	2326.700	1262.000	1076.700
Sum Sq. Dev.	0.105777	16505506	20.00432	2072.275	3635.748	7687.732	2394.385	834.9316
Observations	110	110	110	110	110	110	110	110

Source: Authors Computation E-view 12.0

Table 1 presents the descriptive statistics for the dependent variable (HDI) and independent variables. The average HDI of 0.514 indicates moderate human development among the sampled countries. Agricultural productivity (AP)averages 1,306.25, reflecting varying production capacities, and mechanization rate (MR) vary widely, reflecting uneven technological and infrastructural development.

Table 2: Correlation matrix

Covariance Correlation	HDI	AP	MR	AI	MI	AE
HDI	0.002404					
	1.000000					
AP	23.31861	375125.1				
	0.276508	1.000000				
MR	0.029243	396.6392	0.454644			
	0.384535	0.260444	1.000000			
AI	0.267950	4169.222	4.524907	47.09717		
	0.396320	0.291904	0.277860	1.000000		
MI	0.342053	5525.582	5.852536	61.95044	82.63064	
	0.267456	0.292475	0.354856	0.393062	1.000000	
AE	-0.617104	-5696.293	-6.885108	-62.88201	-82.63463	174.7212
AE	-0.617104	-5696.293	-6.885108	-62.88201	-82.63463	174.7212
	-0.152174	-0.203609	-0.272507	-0.293196	-0.287731	1.000000
AIT	0.299578	3862.580	4.696116	46.12010	58.81626	-63.56833
	0.228268	0.254907	0.344132	0.311008	0.277114	-0.251925
AGDP	-0.206179	-2290.656	-2.637278	-25.54617	-33.66253	55.48121
	-0.365333	-0.258564	-0.297886	-0.154534	-0.250114	0.363550

Source: Authors Computation E-view 12.0

Table 2 displays the correlation matrix examining the relationships between economic development (HDI) and indicators of agricultural transformation among West African countries. HDI shows a positive but weak

correlation with agricultural productivity (AP, 0.277), mechanization rates (MR, 0.385), access to agricultural inputs (AI, 0.396), market integration (MI, 0.267), and the adoption of improved technology (AIT, 0.228), indicating that improvements in these agricultural factors are modestly associated with better human development outcomes in the region.

Table 3: Levin, Lin & Chu unit root Test (LLC)

Variables	LLC Statistics	P-Value	Oder of integration	Remarks
HDI	-1.94772	0.0257	1(0)	Stationary at level
AP	-5.93304	0.0000	1(1)	Stationary at first difference
MR	-4.39376	0.0000	1(1)	Stationary at first difference
AI	-1.73037	0.0418	1(0)	Stationary at level
MI	-6.28419	0.0000	1(0)	Stationary at level
AE	-10.6925	0.0000	1(0)	Stationary at level
AIT	-12.5071	0.0000	1(0)	Stationary at level
AGDP	-10.8721	0.0000	1(0)	Stationary at level

Source: Authors Computation E-view 12.0

The LLC test results indicate that most variables are stationary at level, while AP and MR are stationary after first differencing, confirming the suitability of the data for panel regression analysis

Table 4: Kao Residual Cointegration Test

	t-Statistic	Prob.
ADF	-3.159540	0.0008
Residual variance	1.17E-06	
HAC variance	1.47E-06	

Source: Authors Computation E-view 12.0

The Kao test confirms a long-run equilibrium relationship among variables, with the ADF t-statistic significant at the 1% level.

Table 5: Fixed Effects

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.353470	0.064774	5.456945	0.0000
AP	-5.22E-05	2.31E-05	-2.258473	0.0306

MR	0.016911	0.007940	2.129902	0.0407
AI	0.006800	0.002588	2.627238	0.0130
MI	0.002779	0.000926	3.000773	0.0051
AE	0.000563	0.002412	0.233305	0.8170
AIT	-0.000161	0.000777	-0.207522	0.8369
AGDP	0.001441	0.005270	0.273405	0.7862

Source: Authors Computation E-view 12.0

The fixed effects model indicates significant positive effects of MR, AI, and MI on HDI, while AP has a negative impact. This suggests that agricultural modernization and market integration drive human development more effectively than productivity alone.

Table 6: Model Summary

R-squared	0.9991
Adjusted R-squared	0.9988
F-statistic	3810.42
Prob (F-statistic)	0.0000

Source: Authors Computation E-view 12.0

The model demonstrates a strong explanatory power with an R-squared of 0.9991, confirming that the selected agricultural transformation indicators jointly explain changes in economic development across West African countries.

4.2 Discussions of Findings

The results revealed a statistically significant negative relationship between agricultural productivity (AP) and human development index (HDI). This finding suggests that while productivity gains are essential, they may not automatically translate into improvements in health, education, and living standards within the region. This finding agreed with the works of Maiga (2024) and Sarker et al (2025) that agricultural productivity is critical for sustainable economic growth across regions, though mediated by technology and climate adaptation strategies.

The study found a positive and significant relationship between agricultural mechanization rates (MR) and HDI, indicating that increased mechanization contributes meaningfully to human development in West Africa. Mechanization reduces the drudgery of farming, increases efficiency, and can help smallholder farmers to expand their cultivated areas, thereby improving food security and incomes. This finding agreed with the work of Self and Grabowski (2017) and Sarker et al. (2025) that agricultural modernization and technology adoption are crucial drivers of economic growth and human development.

The study found a positive and significant relationship between agricultural inputs (AI) on economic development, indicating that improved access to quality seeds, fertilizers, and other essential inputs supports higher productivity and incomes, which contribute to better health, education, and living standards as captured by HDI. This underscores the importance of input subsidy programs, timely availability of inputs, and extension services to ensure that smallholder farmers can utilize these inputs effectively to drive agricultural growth and broader economic development in West Africa. This finding agreed with the works of Satyasai and Balanarayana (2018) and Reddy and Dutta (2018) that input factors critically shape agricultural productivity and its cost dynamics

5.Conclusion and Recommendations

5.1 Conclusion

The study concludes by saying agricultural transformation has a significant effect on economic development in West Africa. Mechanization, input access, and market integration drive HDI improvement, while employment and GDP share effects remain limited due to structural constraints. These results indicate that while certain aspects of agricultural transformation contribute positively to human development, structural challenges such as low-value addition, underemployment in agriculture, and inadequate technology utilization hinder the sector's capacity to drive inclusive and sustainable development. The study underscores the need for a holistic transformation of the agricultural sector to translate productivity and growth into tangible improvements in health, education, and living standards in West Africa.

5.2 Recommendations

1. Reform agricultural productivity strategies to link gains with human development.
2. Promote mechanization through subsidized access and farmer training programs.
3. Expand access to quality agricultural inputs through public-private partnerships.
4. Strengthen market integration via infrastructure and trade information systems.
5. Transform agricultural employment into decent, productive jobs with value addition.
6. Encourage inclusive growth through agro industrial linkages and innovation incentives.

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