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Unequal Economic Development and Sustainability Gaps: Cross-Continental Evidence and Strategic Lessons for Urban Health, Food Security, and Climate Resilience in Africa

Ude Kingsley David[1], Okonkwo Ngozi Alice[2], Udemba Klinsmann Uche[3], Okeke Izuchukwu Chetachukwu[4], Ugwueke, Livinus Ifesinachi[5], Nwakozor, Ifeoma Priscilla[6], Ikwu Chukwuebuka Joachim[7]

[1,7]Department of Agricultural Economics, University of Nigeria, Nsukka
[4,5]Department of Economics, Chukwuemeka Ojukwu University, Igbariam, Anambra State
[2]Department of Agricultural Economics, Management and Extension, Ebonyi State University
[3,6]Department of Agricultural Economics and Extension, Nnamdi Azikiwe University, Awka

Corresponding Author:** ***Okeke Izuchukwu Chetachukwu, *Department of Economics, Chukwuemeka Odumegwu Ojukwu University, Igbariam, Anambra State.*

Abstract

Introduction: *Africa faces interconnected challenges of slow economic development, environmental vulnerability, and persistent inequality. Although the continent emits low levels of carbon, it suffers disproportionately from climate impacts, which threaten health, agriculture, and food systems. Addressing these issues requires integrated strategies that link economic, environmental and social dimensions.*

Objectives

i. To analyze economic development indices, environmental sustainability indicators, and inequality patterns across global regions, highlighting their future implications within the one health framework.

ii. To synthesize strategic, cross-continental lessons that can inform and strengthen urban health systems, food security frameworks, and climate resilience strategies in Africa.

Methodology: *This study is based on secondary data obtained from globally recognized organizations such as the UNDP, World Bank, ILO, UNESCO, and others, covering the years 2021 to 2022. The data was standardized to ensure consistency in units and timeframes, allowing for meaningful cross-regional comparisons. Key indicators analyzed include the Human Development Index (HDI), life expectancy, education, gross national income (GNI), and environmental factors like carbon dioxide emissions and material footprint. Descriptive statistics (means and standard deviations) were used to summarize the data, while Analysis of Variance (ANOVA) was employed to assess regional disparities using F-ratios and significance levels. The analysis was conducted across six continents: Africa, Asia, Europe, North America, South America, and Oceania.*

Results: *This study synthesizes strategic, cross-continental insights to inform urban health systems, food security frameworks, and climate resilience strategies in Africa. Findings reveal that Africa lags significantly behind other continents in key human development indicators, with the lowest Human Development Index (HDI = 0.553), life expectancy (62.79 years), and female Gross National Income (GNI = $3,426.96). The continent also records the highest maternal mortality rate (413.02 deaths per 100,000 live births) and the lowest expected years of schooling (10.98 years), indicating weak urban health infrastructure and limited educational outcomes.*

Despite having one of the lowest carbon dioxide emissions per capita (1.11 tonnes), Africa faces disproportionately high environmental pressure (Planetary Pressure Adjustment Factor = 0.961) and scores lowest on the Environmental Sustainability Index (11.91). It also experiences substantial inequality in environmental burdens, with a negative Inequality-Adjusted Carbon Emission Index (-27.02) and Income Inequality-Adjusted Environmental Footprint Index (-35.05). The Gender Development Index (0.911) and labour force participation rates (female = 53.48%, male = 68.42%) highlight persistent gender disparities across economic and development dimensions. Compared to continents like Europe (HDI = 0.880, life expectancy = 79.61 years) and Asia (CO_2 emissions = 6.80 tonnes per capita), Africa's position underscores the need for integrated, equity-driven strategies.

Conclusions: *The study concludes that Africa must strengthen community-based health systems, promote inclusive education and gender equity, and adopt sustainability-oriented urban planning. Cross-continental best practices show that aligning human development with climate resilience and gender inclusivity is essential for building sustainable African cities.*

Keywords: *Economic Development, Environmental Sustainability, Inequality, One Health, Agriculture, Climate Resilience.*

1. INTRODUCTION

Africa is at the forefront of a dynamic and complex interplay between economic development, environmental sustainability, and public health, all of which are deeply affected by persistent inequalities. Despite significant strides in human development, the continent continues to face major disparities in income, education, and access to healthcare, which hinder its ability to achieve long-term, sustainable growth. Health outcomes in Africa are particularly concerning, with the region grappling with lower life expectancy, higher maternal mortality rates, and widespread health inequities. The World Bank (2021) highlights that Africa's maternal mortality rates remain among the highest globally, pointing to critical gaps in healthcare infrastructure. These challenges are further exacerbated by environmental pressures, as climate change intensifies the risk of food insecurity, water scarcity, and the spread of infectious diseases. The World Health Organization (WHO) et al. (2022) emphasizes that environmental stressors have direct implications for public health, placing additional strain on already fragile healthcare systems across the continent.

Gender disparities further complicate this scenario, as women in Africa face greater obstacles in accessing education, earning equitable incomes, and receiving adequate healthcare, contributing to broader socio-economic inequalities. UNICEF (2022) reports that women and children in rural areas are disproportionately affected by these gaps, particularly in access to maternal and reproductive health services. Such disparities hinder inclusive development, making it difficult for Africa to achieve balanced growth. For example, UNESCO (2022) points out that limited access to education, especially for girls, constrains opportunities for economic advancement, further entrenching gender inequalities. Addressing these gender disparities is crucial for achieving sustainable development, as equitable access to education and healthcare for women would enhance both human and economic capital across the continent.

In addition to these internal inequalities, global environmental pressures exacerbate Africa's vulnerabilities. The United Nations Environment Programme (UNEP, 2022) underscores that climate change is intensifying environmental degradation in the region, leading to challenges such as deforestation, land degradation, and the depletion of water resources. These environmental issues, if not addressed, could worsen food insecurity and accelerate rural poverty. The continent's dependence on rain-fed agriculture makes it particularly susceptible to unpredictable weather patterns caused by climate change. The United Nations Department of Economic and Social Affairs (UNDESA, 2022b) notes that rural communities, which are already marginalized economically, face increased risks as agricultural productivity declines, leading to reduced incomes and higher levels of food insecurity.

This study provides an integrated analysis of Africa's economic, environmental, and health challenges within the global context. By comparing key indicators across regions, it highlights the continent's unique vulnerabilities, particularly in relation to public health and environmental sustainability. As the World Bank (2022) shows, income disparities between African countries and other global regions remain stark, contributing to the region's slower economic growth and limiting its ability to respond effectively to crises such as pandemics or environmental shocks. Furthermore, UNESCO (2022) suggests that improving educational outcomes, particularly in rural areas, would be essential for equipping communities with the knowledge and skills needed to adopt sustainable practices and build resilience against environmental threats. In conclusion, addressing Africa's interlinked economic, health, and environmental challenges is crucial not only for improving public health outcomes but also for fostering resilience against environmental degradation and promoting inclusive development. As the climate era accelerates, understanding and addressing these challenges will be critical for shaping Africa's future in a sustainable and equitable manner. The region's ability to build resilience will depend on integrated efforts that bridge gaps in education, healthcare, and environmental sustainability, ensuring that the continent can thrive amid global environmental and economic pressures (UNICEF, 2022**;** UNEP, 2022)**.**

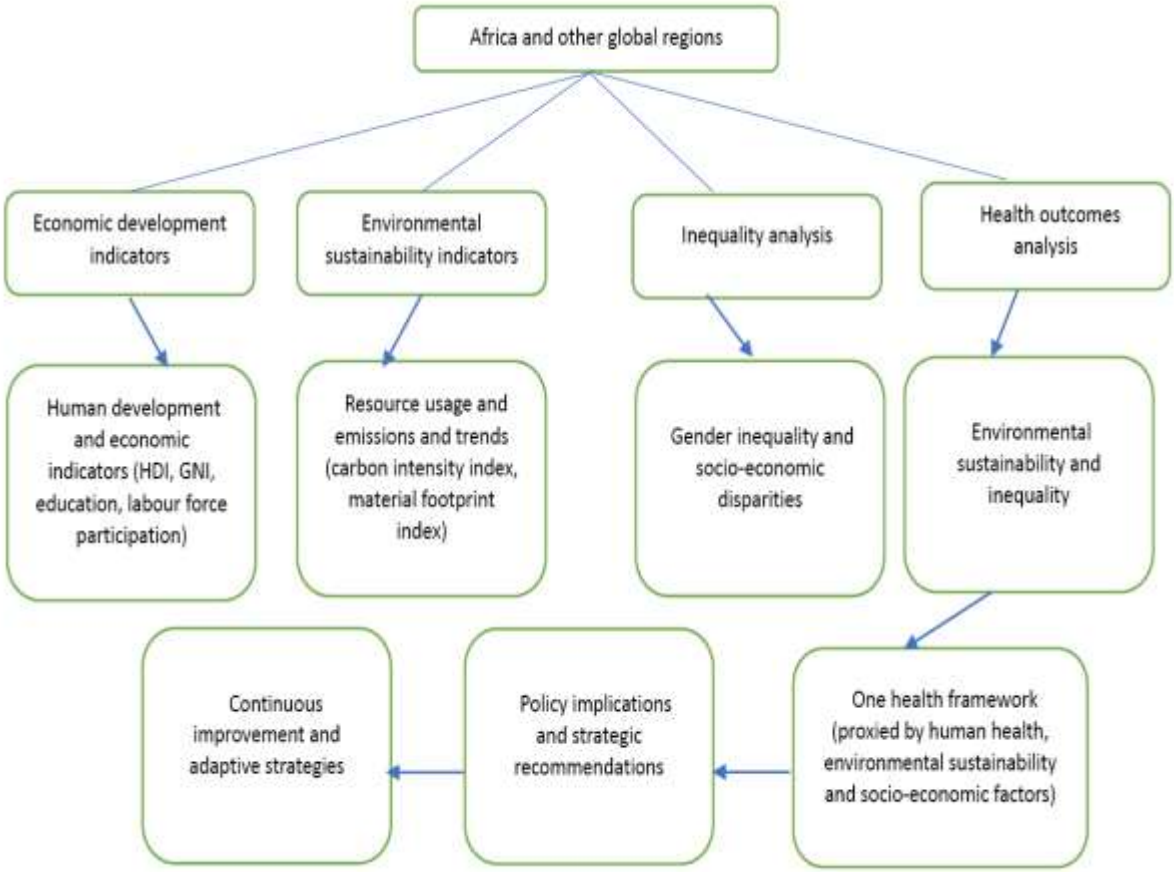
2. OBJECTIVES OF THE STUDY

The broad objective is to conduct a comprehensive comparative analysis of economic development, environmental sustainability, inequality, and health outcomes between Africa and other global regions, identifying Africa's unique challenges and opportunities in the context of global climate change and development within the One Health framework. Specifically, the study

- Analyze economic development indices, environmental sustainability indicators, and inequality patterns across global regions, highlighting their future implications within the one health framework.
- Synthesize strategic, cross-continental lessons that can inform and strengthen urban health systems, food security frameworks, and climate resilience strategies in Africa.

3. Literature Review

3.1. Conceptual framework



Source: *Authors' Conceptualization (2024).*

The central objective of the framework is to conduct a comprehensive comparative analysis of economic development, environmental sustainability, inequality, and health outcomes between Africa and other global regions within the One Health framework. This central aim underscores the study's goal to understand the interconnections between these domains and how Africa's specific challenges and opportunities compare globally. The economic development indicators component evaluates key factors such as the Human Development Index (HDI), Gross National Income (GNI), education levels, and labour force participation. These indicators are crucial for assessing overall development, economic capacity, and access to education across different regions.

They also help identify growth areas and inequality within Africa compared to other regions. Environmental sustainability is assessed by examining resource usage, emissions, and trends in sustainable development efforts. This component highlights how different regions manage their natural resources and their impact on the environment. The comparison of these sustainability indicators helps pinpoint Africa's position relative to global efforts and trends in responding to environmental challenges. The framework also includes a thorough inequality analysis, focusing on gender and socio-economic disparities. By comparing life expectancy, education, and labour force participation across regions, this component aims to understand how these inequalities affect social equity and development both within Africa and globally. It provides insights into how disparities in these areas contribute to broader developmental challenges.

Health outcomes are evaluated in relation to environmental sustainability and inequality. This involves analysing maternal mortality, life expectancy, and overall health impacts to understand how disparities in economic and environmental factors influence public health and well-being. The health outcomes component provides a critical view of how various regional factors interplay to affect health. At the core of the framework is the One Health approach, which integrates proximately human health, environmental sustainability, and socio-economic factors. This integrated perspective, represented by various indices, helps link human development with environmental impacts and health outcomes. It underscores the interconnected nature of these factors and supports a holistic view of the issues at hand. The framework also includes policy implications and strategic recommendations aimed to address identified challenges and leverage opportunities for improvement across the regions studied as well as continuous improvement emphasized through adaptive strategies which highlights the need for ongoing adjustments based on new data and insights, ensuring that the analysis remains relevant and actionable over time.

4. Research Methodology

The study utilizes secondary data sourced from reputable global databases and organizations, including the United Nations Development Programme (UNDP 2022), World Bank (WB 2021, 2022), Eurostat (2021), Global Carbon Project (GCP 2022), International Labour Organization (ILO 2022), CEDLAS & World Bank (CEDLAS & WB 2022), ICF Macro (2022), Inter-Parliamentary Union (IPU 2022), Luxembourg Income Study (LIS 2022), Organisation for Economic Co-operation and Development (OECD 2022), United Nations Department of Economic and Social Affairs (UNDESA, 2022), United Nations Environment Programme (UNEP 2022), UNESCO Institute for Statistics (UNESCO UIS 2022), United Nations Children's Fund (UNICEF 2022), United Nations Statistics Division (UNSD 2022), and World Inequality Database (WID 2022). The data spans between years 2021 and 2022, ensuring a fair robust analysis of trends and variations. Data from diverse sources were standardized to ensure consistency in measurement units and formats.

This process includes converting various economic and environmental metrics into comparable units and aligning the time periods covered by the datasets. For instance, indicators like the Human Development Index (HDI) and carbon dioxide emissions per capita were harmonized to a common scale to facilitate cross-regional comparisons. The core of the analysis involves comparative statistics across different continents: Africa, Asia, Europe, North America, South America, and Oceania. Descriptive statistics, including means and standard deviations, were computed for each parameter to summarize the data. The analysis focuses on key indicators such as HDI, life expectancy, educational attainment, gross national income (GNI), and environmental metrics like carbon dioxide emissions and material footprint. A significant component of the analysis is the calculation of the F-ratio and significance levels (denoted by Sig.) for each parameter using ANOVA. The F-ratio assesses the variance between regions relative to the variance within regions, providing insight into the extent of regional disparities.

5. Result and Discussion

5.1. Economic development indices, environmental sustainability indicators, and inequality patterns across global regions, highlighting their future implications within the one health framework.

5.1.1. Economic Development Indices

Table 1 provides an insightful comparative analysis of key economic development indicators across continents, highlighting the stark inequalities between Africa and other regions of the world. Africa's Human Development Index (HDI), at 0.553, is significantly lower than the global average of 0.717, representing just 77.13% of the world average. This disparity becomes even more apparent when compared to Europe, where the HDI is 0.880, and North America, with an HDI of 0.749. These figures underscore the substantial developmental challenges Africa faces, particularly in terms of human development outcomes. In terms of life expectancy at birth, Africa's average of 62.785 years is considerably below the global average of 71.276 years, indicating a shortfall of nearly 9 years.

This discrepancy reflects the continent's struggle with health outcomes, including inadequate healthcare infrastructure, high rates of infectious diseases, and other factors contributing to lower longevity. Compared to Europe (79.612 years) and North America (78.810 years), Africa's life expectancy

highlights the significant health burden the continent bears, achieving only 88.09% of the world average. Africa's expected years of schooling further reveal an educational deficit. With an average of 10.982 years, it falls short of the global average of 13.489 years. This gap underscores challenges in educational access and quality, which are exacerbated by factors such as poverty, conflict, and inadequate educational resources. When contrasted with Europe (16.418 years) and North America (16.374 years), Africa's schooling years signify a critical need for educational reform and investment.

Economic inequality is further illustrated by Gross National Income (GNI) per capita, where Africa's average of $5,338.534 is drastically lower than the global average of $20,048.981. This disparity is especially pronounced when compared to Europe, where GNI per capita stands at $41,819.213, and North America, with $17,544.246. These figures underscore Africa's economic challenges, which are rooted in factors such as lower productivity, limited access to global markets, and political instability. The result on inequality metrics paints an even starker picture. Africa's coefficient of human inequality is 28.130, far exceeding the global average of 18.204. This reflects significant disparities in life expectancy, education, and income within the continent, suggesting that while some regions or individuals may be thriving, vast numbers of the population remain marginalized.

This is also evident in the Gini coefficient, which measures income inequality. Africa's Gini coefficient of 41.400 is higher than the world average of 37.102, underscoring the continent's deeply entrenched income inequalities. Maternal mortality rates in Africa, at 413.020 deaths per 100,000 live births, are alarmingly high, far exceeding the global average of 155.290. This statistic highlights critical gaps in healthcare services, particularly in maternal and child health, and reflects broader challenges in healthcare access, quality, and infrastructure. Finally, labour force participation rates are relatively comparable across continents, with Africa's rate of 60.934% being slightly above the world average of 58.671%. This suggests that while Africa faces numerous challenges in terms of health, education, and income inequality, the continent's labour force remains active and engaged.

However, the economic returns from this participation may be limited due to the underlying inequalities and structural barriers prevalent in the region. The disparities in economic development indicators, particularly within the One Health framework, present significant future challenges for Africa. Low life expectancy and high maternal mortality rates serve as stark indicators of an overstretched healthcare system. Without substantial improvements, Africa is likely to face an increasing burden of both communicable diseases like malaria and tuberculosis, and non-communicable diseases such as diabetes and heart disease, which are rising due to lifestyle changes. As these health challenges intensify, healthcare systems could become overwhelmed, leading to higher mortality rates and reduced life expectancy.

The high maternal mortality rate also highlights critical gaps in reproductive and maternal healthcare, especially in rural areas. If these trends continue, poor maternal and child health outcomes will hinder population growth and economic productivity. Moreover, insufficient investment in healthcare infrastructure will exacerbate health inequalities, leaving rural and marginalized communities particularly vulnerable to future health crises, including the potential for pandemics that could devastate underfunded health systems (WHO et al., 2019; World Bank, 2022).In the agricultural sector, which is central to Africa's economy, significant challenges lie ahead if current economic indicators remain unchanged.

Low gross national income (GNI) per capita reflects widespread poverty, limiting farmers' ability to access modern technologies, finance, and markets that are critical for improving productivity. Coupled with educational deficits, many farmers may lack the knowledge and skills necessary to adopt modern agricultural practices, such as climate-smart techniques and agroecology. These practices are essential for mitigating the impacts of climate change on agriculture. Consequently, agricultural productivity may stagnate or even decline, leading to increased food insecurity and malnutrition. Additionally, the severe income inequality, as indicated by the Gini-coefficient, suggests that rural populations—especially smallholder farmers—are likely to remain impoverished, further limiting economic mobility and perpetuating rural poverty. This could create a vicious cycle where poverty impedes agricultural development, and weak agricultural growth exacerbates poverty (UNDESA, 2022b; World Bank, 2021).

Table 1. *Comparative Analysis of Economic Development, Environmental Sustainability, and Inequality across the Globe*

Parameters	Africa	Asia	Europe	North America	South America	Oceania	F ratio (Sig.)	World average	Africa/ world (%)
Economic development									
HDI	0.553	0.731	0.880	0.749	0.754	0.701	49.211***	0.717	77.13
LifeExpectancy at Birth	62.785	73.404	78.708	72.979	71.815	70.112	50.006***	71.276	88.09
Expected years of schooling SDG 4.3(years)	10.982	13.408	16.099	13.932	14.815	13.374	25.517***	13.489	81.41
Grossnational income (GNI) percapita(SDG8.5) PPP $)	5338.534	21332.719	41819.213	17544.246	14873.115	12518.538	25.648***	20048.981	26.63
Coefficient of human inequality	28.130	15.916	8.057	19.141	17.760	18.500	57.395***	18.204	154.53
Inequality in life Expectancy (%)	24.237	10.704	3.805	9.729	10.313	13.031	60.119***	12.923	187.55
Inequality in education (%)	30.973	17.863	6.340	12.408	12.475	9.151	26.408***	17.293	179.11
Inequality in income (%)	27.726	19.433	14.765	28.705	30.532	22.985	22.457***	22.708	122.10
Ginicoefficient	41.400	34.125	31.398	42.148	43.192	35.150	19.649***	37.102	111.58
Maternal mortality ratio (deaths per 100,000 live births)	413.020	74.850	8.950	74.430	84.330	90.570	38.726***	155.290	265.97
Labour force participation rate	60.934	57.077	56.432	58.047	61.276	61.240	1.089	58.671	103.86
Environmental sustainability									
Adjustment factor for planetary pressures (values)	0.961	0.8707	0.840	0.918	0.928	0.925	11.891***	0.902	106.54
Carbon dioxide emissions per capita (production) (tonnes)	1.114	6.804	6.104	4.342	2.406	3.617	8.238***	4.281	26.02
Carbon dioxide emissions (production) index (tonnes)	0.983	0.900	0.911	0.936	0.964	0.947	8.238***	0.937	104.91
Material footprint per capita (tonnes)	6.347	16.862	24.820	12.577	12.107	11.537	10.951***	14.565	43.58
Material footprint index (value)	0.940	0.843	0.768	0.882	0.887	0.892	10.951***	0.864	108.80
Inequality									
Gender Development Index (value)	0.91083	0.92606	0.99109	0.96978	0.98417	0.93679	13.280***	0.94602	96.28
HDI (female)	0.529	0.700	0.869	0.735	0.746	0.649	47.135***	0.694	76.22
HDI (male)	0.579	0.750	0.878	0.757	0.758	0.690	46.474***	0.728	79.53
Life expectancy at birth (female) years	65.088	76.166	81.679	76.104	75.170	72.821	57.085***	74.034	87.92
Life expectancy at birth (male) years	60.567	70.812	75.794	70.019	68.659	67.714	41.586***	68.651	88.22
Expected years of schooling (female)	10.893	13.563	16.716	14.551	15.312	13.560	26.917***	13.759	79.17
Expected years of schooling (male)	11.182	13.329	15.844	13.599	14.255	12.890	41.585***	13.359	83.70
Estimated gross national income per capita (female)	3426.963	13508.686	31232.777	12746.119	10953.206	8947.540	27.970***	14141.435	24.23
Estimated gross national income per capita (male)	6484.674	27486.901	46140.167	20589.485	18888.301	14473.272	23.198***	23602.844	27.47
Labour force participation rate (female)	53.481	43.540	52.008	48.996	51.307	55.361	2.651**	50.174	106.59
Labour force participation rate (male)	68.388	70.613	60.856	67.098	71.246	67.119	3.322***	67.169	101.81
Environmental Health									
Human Development and Environmental Index (HDEII)	8.954	17.239	25.000	13.001	12.476	12.100	8.713***	15.534	57.64
Carbon Emission Intensity Index (CEII)	0.000146	0.000369	0.000179	0.000222	0.000193	0.000280	5.035***	0.000230	63.48
Material Intensity Index (MII)	0.000382	0.000137	0.0000248	0.0000868	0.0000736	0.000164	18.088***	0.000172	222.09

Gender Adjusted Environmental Index (GAEI)	11.379	17.379	25.027	13.179	12.592	12.363	6.598***	16.293	69.84
Inequality Adjusted Carbon Emission Index (IACEI)	-27.015	-9.111	-1.952	-14.798	-15.354	-14.883	39.603***	-13.923	194.03
Environmental Sustainability Index (ESI)	11.912	17.442	25.000	13.183	12.564	12.391	6.172***	16.451	72.41
Life Expectancy Adjusted Carbon Index (LEACI)	0.016	0.090	0.077	0.058	0.033	0.049	7.577***	0.056	28.57
Income Inequality Adjusted Environmental Foot print Index (IIAEI)	-35.052	-17.262	-6.577	-29.570	-31.084	-23.612	20.351***	-22.536	155.54
Human Development and Carbon Footprint Index (HDCFI)	2.607	0.377	0.180	0.424	0.368	0.563	14.012***	0.968	269.32
Educational Impact on Environmental Footprint Index (EIEFI)	3.410	1.909	0.912	1.480	1.414	1.888	7.523***	2.017	169.06
Gender and Income Environmental Impact Index (GIEII)	1.151	6.858	6.178	4.380	2.440	3.661	8.302***	4.330	26.58
Health and Environmental Sustainability Index (HESI)	345.274	59.072	41.004	57.030	47.351	72.786	12.403***	134.274	257.14
Maternal Mortality and Environmental Impact Index (MMEII)	3347.489	120.047	26.909	123.019	53.602	99.534	9.427***	987.573	338.96
Labour Force Participation and Environmental Footprint Index (LFPEFI)	22.084	9.356	3.188	6.630	5.882	9.677	7.867***	10.977	201.18
Environmental Equality Index (EEI)	82.962	48.032	24.944	50.869	53.345	45.197	52.048***	52.953	156.67
Adjusted Gender Development Index for Environmental Impact (AGDIEI)	0.256	0.097	0.042	0.088	0.075	0.104	13.786***	0.127	201.57
Economic Productivity and Carbon Emission Index (EPCEI)	10919.100	4683.379	7998.418	6071.247	6939.803	4845.090	8.232***	7472.367	146.13
Life Expectancy Inequality-Adjusted Environmental Impact Index (LEIAEII)	2.137	2.736	2.634	3.123	3.012	2.798	4.632***	2.614	81.75

Source: *(UNDP 2022; CEDLAS & WB 2022; Eurostat 2021; GCP 2022; ICF Macro 2022; ILO 2022; IMF 2021, 2022; IPU 2022; LIS 2022; OECD 2022; UNEP 2022; UNESCO UIS 2022; UNICEF 2022; UNSD 2022; WHO/UNICEF/UNFPA; WB 2021, 2022; WID 2022)*

From an environmental perspective, Africa's low carbon emissions per capita and modest material footprint highlight the continent's small contribution to global climate change. However, this does not equate to a minimal environmental impact. Africa's challenges with resource management and its higher vulnerability to planetary pressures make it susceptible to environmental degradation, including deforestation, biodiversity loss, and the depletion of natural resources. As environmental pressures mount, Africa may struggle to balance development with sustainable environmental practices. If resource use remains inefficient and development does not align with sustainable principles, the continent could face significant environmental degradation, endangering both ecosystems and the livelihoods of its populations (UNESCO, 2022; World Inequality Database, 2022; World Bank, 2021; UNDESA, 2022b).

5.1.3. Inequality

In examining inequality, Africa's Gender Development Index (GDI) stands at 0.91083, which is notably lower than the global average of 0.94602. This indicates significant gender disparities across various dimensions, including human development, life expectancy, and educational attainment. The lower GDI reflects the ongoing gender inequality issues that impact both economic and social outcomes in the region. Specifically, the Human Development Index (HDI) for females in Africa is 0.529, which is considerably lower than the HDI for males at 0.579. Both figures are below the world averages of 0.694

for females and 0.728 for males. This disparity highlights the systemic inequalities that hinder the overall development and well-being of women compared to men in Africa. Similarly, life expectancy at birth for females in Africa is 65.088 years, while for males it is 60.567 years. These figures are lower than the global averages of 74.034 years for females and 68.651 years for males, indicating that women and men in Africa face significant health challenges and shorter lifespans compared to their counterparts worldwide. Educational attainment also reflects gender disparities. Expected years of schooling for females in Africa is 10.893 years, which is lower than the 11.182 years for males. Both figures fall short of the world averages, further emphasizing the educational inequalities present in the region. This gap in educational attainment contributes to broader socio-economic disadvantages for women. Economic disparities are evident in the estimated gross national income (GNI) per capita, where females in Africa earn $3,426.963 compared to $6,484.674 for males. This substantial difference underscores the economic inequalities faced by women in Africa, affecting their access to resources and opportunities. Labour force participation rates further highlight gender disparities, with males participating at a rate of 68.388% compared to 53.481% for females. This lower participation rate for women reflects broader issues related to economic inclusion and employment opportunities. Additionally, gender disparities are evident in indices related to environmental and economic impacts, underscoring the multifaceted nature of gender inequality in Africa. The futuristic implications of gender inequalities on One Health, agriculture, and the environment in Africa are profound and far-reaching. From a One Health perspective, the disparities in the Gender Development Index (GDI) and life expectancy figures suggest that women in Africa will continue facing unique health challenges distinct from those of men. The lower life expectancy for both women and men in Africa, compared to global averages, implies that inadequate healthcare access, malnutrition, and disease outbreaks will remain major issues. For women, these challenges are compounded by limited access to healthcare services, particularly in maternal and reproductive care. Persisting gender inequalities in education and income mean that women are more likely to suffer from preventable diseases and inadequate healthcare, which will further widen the health gap between genders and between Africa and other global regions (ILO, 2022; UNDESA, 2022a).

In agriculture, gender inequality could severely affect productivity and sustainability. Women, who constitute a significant portion of Africa's agricultural workforce, face limited access to essential resources like land, credit, and technology. These disparities could hinder efforts to enhance agricultural efficiency and food security. Women's lower educational attainment restricts their capacity to adopt innovative agricultural practices or access vital knowledge that could improve productivity. This imbalance might aggravate future food insecurity as women remain excluded from decision-making processes and resource allocation in the agricultural sector. Moreover, as climate change and environmental degradation escalate, the limited economic power of women will make it even more difficult for them to adapt, particularly in rural areas where agriculture is a primary livelihood (IMF, 2022; OECD, 2022).

The environmental implications of gender inequality are also significant. In rural areas, women in Africa are particularly dependent on natural resources for their livelihoods, engaging in farming, water collection, and fuel wood gathering. As climate change, deforestation, and resource depletion intensify, women are likely to be disproportionately affected. Without equal access to education and economic opportunities, women will face significant challenges in developing resilience strategies to cope with these environmental pressures. The economic disparity between men and women, as reflected in gross national income (GNI) figures, further limits women's ability to invest in sustainable practices or shift to more resilient livelihoods. This not only endangers their well-being but also undermines broader environmental conservation efforts, which are essential to long-term sustainability (IPU, 2022; UNDESA, 2019; Luxembourg Income Study, 2022). To mitigate these challenges, Africa must address gender disparities through cross-sectoral initiatives that integrate healthcare, agricultural policies, and environmental sustainability. A focus on empowering women through education, healthcare access, and equitable resource allocation in agriculture can improve resilience against the future impacts of climate change, economic challenges, and public health crises (ILO, 2022; IMF, 2021).

5.1.4. Health-related indices

In Africa, the health-related indicators reflect significant challenges compared to other regions and the world averages. The Human Development and Environmental Index (HDEII) for Africa is notably low at 8.954, which is substantially below the global average of 15.534. This indicates that Africa faces

difficulties in aligning human development with environmental sustainability, reflecting systemic issues in achieving a balance between growth and environmental protection.

In contrast, regions like Europe and North America have higher HDEII values, suggesting they have been more successful in integrating these aspects. The Carbon Emission Intensity Index (CEII) in Africa stands at 0.000146, which is lower than the global average of 0.000230. This indicates that Africa contributes less to carbon emissions relative to its population size and economic activities. However, this lower value also highlights that as Africa continues to develop, it must be cautious to avoid increasing its carbon footprint. Regions like Asia and Europe have higher CEII values, reflecting their more significant industrial activities and emissions.

Africa's Material Intensity Index (MII) is 0.000382, higher than the global average of 0.000172. This suggests that the continent uses more resources per unit of economic output, pointing to inefficiencies in resource utilization. In comparison, more developed regions such as Europe have a lower MII, indicating more efficient use of materials in their economies. The Gender Adjusted Environmental Index (GAEI) in Africa is 11.379, lower than the world average of 16.293. This indicates that gender disparities in Africa may be hindering effective environmental sustainability efforts. Regions like Europe, which have higher GAEI values, show that addressing gender disparities contributes positively to environmental outcomes. The Inequality Adjusted Carbon Emission Index (IACEI) for Africa is -27.015, reflecting significant negative impacts of inequality on carbon emissions. This contrasts sharply with the global average of -13.923, underscoring that income inequality in Africa exacerbates environmental degradation more severely than in other regions. Wealthier individuals in Africa contribute disproportionately to carbon emissions, while the poorer populations suffer from greater environmental vulnerabilities.

The Environmental Sustainability Index (ESI) in Africa is 11.912, which is lower than the global average of 16.451. This lower score reflects ongoing challenges in achieving sustainability, with Africa struggling more than regions like Europe and North America to manage environmental impact effectively. The Life Expectancy Adjusted Carbon Index (LEACI) in Africa is 0.016, which is lower than the global average of 0.056. This suggests that despite improvements in life expectancy, carbon emissions in Africa remain relatively low. However, this may change as development progresses unless sustainable practices are adopted. The Income Inequality Adjusted Environmental Footprint Index (IIAEI) is -35.052 in Africa, significantly more negative than the global average of -22.536. This highlights how income inequality in Africa exacerbates environmental impact, with wealthier segments consuming more resources and contributing more to environmental degradation compared to poorer regions. Finally, the Human Development and Carbon Footprint Index (HDCFI) in Africa is 2.607, far lower than the global average of 0.968. This stark difference suggests that Africa's progress in human development is not yet well-aligned with reducing carbon footprints, contrasting with the more developed regions where human development and carbon management are better integrated.

The futuristic implications of Africa's health-related metrics on health, agriculture, and the environment reveal profound challenges that could significantly shape the region's future. Africa’s Human Development and Environmental Index (HDEII) of 8.954, substantially below the global average of 15.534, highlights the continent's low performance in human development and environmental sustainability. This disparity indicates that Africa may face growing difficulties in balancing health improvements with environmental protection. If these challenges are not addressed, Africa could witness an increase in health-related issues such as malnutrition, the spread of diseases, and limited access to healthcare. With rising populations and mounting environmental pressures, healthcare systems will be under strain, widening the health outcome gap between Africa and other regions. To avoid this, systemic changes in healthcare infrastructure, environmental policies, and cross-sectoral collaboration are needed (CEDLAS & World Bank, 2022; Eurostat, 2021).

In the agricultural sector, Africa's lower Carbon Emission Intensity Index (CEII) and Material Intensity Index (MII) may initially appear advantageous but in reality, reflect limited industrialization and technological advancement rather than deliberate environmental stewardship. As climate change escalates, these indices may signal vulnerabilities instead of strengths. Africa’s agriculture, largely dependent on natural resources and small-scale farming, is already challenged by unpredictable weather, reduced soil fertility, and resource depletion. Without improvements in health metrics—

particularly in maternal health, where Africa's Maternal Mortality and Environmental Impact Index (MMEII) is alarmingly high at 3347.489 compared to the global average of 987.573—agricultural productivity will likely decline. Poor health, including malnutrition, weakens the labour force, and Africa's ability to adopt climate-smart agricultural practices will be constrained by inadequate health and education systems (ICF Macro, Various Years; Barro & Lee, 2018).

Gender disparities, as shown by the Gender Adjusted Environmental Index (GAEI), indicate that women, who play a pivotal role in agriculture, may bear a disproportionate share of health and environmental burdens, further limiting the sector's resilience. Environmentally, Africa's low ranking in the Environmental Sustainability Index (ESI) and Health and Environmental Sustainability Index (HESI) signals the continent's struggle to manage its environmental resources. As development expands, the environmental footprint increases, putting additional strain on ecosystems. This exacerbates health risks, including waterborne diseases, air pollution-related illnesses, and malnutrition due to food insecurity (Global Carbon Project, 2022). The Inequality Adjusted Carbon Emission Index (IACEI) underscores how environmental degradation disproportionately affects poorer and more vulnerable communities, who will likely bear the brunt of these changes. Additionally, labour force participation, reflected in the Labour Force Participation and Environmental Footprint Index (LFPEFI), will suffer as health challenges undermine workers' capacity to contribute effectively to both agricultural and industrial sectors. Addressing these interconnected issues is crucial to improving Africa's health outcomes, agricultural productivity, and environmental sustainability in the future (CEDLAS & World Bank, 2022; Eurostat, 2021).

5.2. Cross-Continental Insights to Strengthen Urban Health, Food Security, and Climate Resilience in Africa

Africa's substantially lower Human Development Index (0.553) and life expectancy (62.785 years) compared to Europe (HDI = 0.880, life expectancy = 79.612 years) and North America (HDI = 0.749, life expectancy = 78.810 years) highlight persistent weaknesses in the continent's health infrastructure. These disparities reflect not only inadequate healthcare services but also systemic underinvestment in urban health systems, particularly in maternal and child health, as illustrated by the continent's high maternal mortality rate of 413.020 deaths per 100,000 live births. In contrast, continents with higher life expectancy and lower maternal mortality have invested consistently in universal health coverage, health workforce development, and resilient urban health networks. Strategic lessons from these regions suggest that Africa must prioritize scaling up community-based primary healthcare, invest in maternal and reproductive health infrastructure, and ensure consistent access to essential medicines and diagnostics in urban settings. Additionally, adopting digital health platforms—prevalent in advanced regions—can enhance disease surveillance, health education, and service delivery in rapidly growing African cities.

5.2.1. Informing Food Security Frameworks

The continent's relatively active labour force participation rate (60.934%) offers a demographic advantage that can be harnessed to strengthen food security frameworks. However, low educational attainment (expected years of schooling: 10.982) and significant gender disparities in income (females: $3,426.96 vs. males: $6,484.67) and participation (female labour force: 53.481%) limit productivity and innovation in food systems. In regions like Europe and Asia, higher education and more gender-inclusive policies have contributed to more efficient and resilient food systems. Africa must therefore integrate inclusive education policies and empower women economically to enhance agricultural innovation and urban food system efficiency. Further, Africa's income inequality (Gini coefficient: 41.400) and high human inequality (28.130) suggest that urban food security frameworks must address structural barriers such as unequal land access, employment disparities, and food affordability gaps. Regions with more equitable economic systems tend to achieve better outcomes in food access and nutrition. Africa can also learn from cross-continental programs that integrate social protection schemes, school feeding initiatives, and nutrition-sensitive urban agriculture to support vulnerable populations.

5.2.2. Building Climate Resilience Strategies

Although Africa's carbon dioxide emissions per capita (1.114 tonnes) are much lower than those of Asia (6.804 tonnes) and Europe (6.104 tonnes), the continent faces disproportionately high

environmental pressures, as reflected by its high planetary pressure adjustment factor (0.961) and poor performance on the Environmental Sustainability Index (11.912 vs. global average of 16.451). This paradox—low emissions but high vulnerability—underscores the urgent need for tailored climate resilience strategies. Lessons from Europe and North America, which have successfully mainstreamed environmental efficiency into their economies, show that investing in low-carbon technologies, improving resource efficiency (e.g., reducing Africa's Material Intensity Index of 0.000382), and enhancing environmental governance can build urban resilience. Furthermore, Africa's negative Inequality Adjusted Carbon Emission Index (-27.015) and Income Inequality Adjusted Environmental Footprint Index (-35.052) reveal that climate resilience must be equity-driven. Wealthier populations contribute more to environmental degradation while the poor suffer more from climate shocks. Thus, resilience strategies in Africa should integrate pro-poor climate policies, support informal urban settlements, and empower communities to participate in climate governance, drawing on participatory planning models from Asia and Latin America.

5.2.3. Gender-Inclusive Approaches to Urban Systems and Sustainability

Africa's Gender Development Index (0.91083), far below the global average (0.94602), points to deeply embedded gender inequality that hampers effective urban development and sustainability. This is further evidenced by gender gaps in health, education, and income, with women experiencing lower HDI scores (0.529 vs. 0.579 for men) and significantly lower GNI per capita. In contrast, regions that have reduced gender gaps—like Europe and parts of Latin America—show greater success in implementing inclusive urban systems and environmental sustainability measures. Africa can draw lessons from these regions by institutionalizing gender budgeting, promoting female leadership in urban planning, and ensuring women's access to land, finance, and technology. Addressing these gender disparities is not only a matter of equity but also a prerequisite for building stronger food systems, improving household health outcomes, and accelerating climate adaptation at the community level.

5.2.4. Integrated Human-Environment Development Pathways

Africa's low scores in integrated development indices—such as the Human Development and Environmental Index (HDEII = 8.954), the Gender Adjusted Environmental Index (GAEI = 11.379), and the Human Development and Carbon Footprint Index (HDCFI = 2.607)—signal a misalignment between human progress and environmental stewardship. More developed continents have achieved higher integration, suggesting that aligning urban development with sustainability principles is both feasible and essential. This calls for Africa to adopt urban growth strategies that prioritize sustainable transport, renewable energy, green infrastructure, and circular economy practices. Urban planning in Africa must embrace nature-based solutions and disaster risk reduction strategies, as seen in climate-resilient cities in Southeast Asia. Moreover, policies that address inequality while promoting sustainability—such as inclusive green jobs and social-ecological safety nets—are crucial to achieving balanced development outcomes.

6. CONCLUSION

In conclusion, this study underscores the critical interplay between unequal economic development and sustainability gaps across continents, offering vital strategic lessons for bolstering urban health systems, food security frameworks, and climate resilience in Africa. The cross-continental synthesis revealed that regions with higher Human Development Index (HDI) levels—such as Europe and North America—demonstrated stronger urban health systems and better outcomes in gender equality, education, and environmental sustainability, despite contributing disproportionately to global carbon emissions and material footprints. Conversely, Africa, while facing lower carbon emissions and resource use, continues to grapple with the compounded burdens of poverty, gender disparities, weak health infrastructure, and high maternal mortality rates—issues exacerbated by climate vulnerability.

The findings highlight a stark imbalance: Africa bears the brunt of planetary pressures without commensurate developmental benefits. Lessons from more developed regions emphasize the importance of investing in equitable education, inclusive labor force participation, and gender-responsive policy implementation to build systemic resilience. Moreover, the evidence points to the need for integrated policies that tackle environmental degradation while addressing social and economic inequities. For African countries, a shift toward inclusive and ecologically sustainable development

pathways is not just desirable but essential. Strategic international cooperation, grounded in equity and mutual accountability, must prioritize African urban systems as critical frontiers for global sustainability and resilience-building efforts.

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