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Inclusive Human Development in Sub-Sahara Africa: Does the Environmental Quality Matter?

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Abstract

The improvement of human well-being is the fundamental objective of the scramble for environmental sustainability. This study aims to investigate the effect of environmental sustainability on inclusive human development in Sub-Saharan Africa. Through the application of a system-GMM to a sample of 49 Sub-Saharan African countries from 2010 to 2017, we found a positive and statistically significant effect of environmental sustainability on inclusive human development in Sub-Saharan countries. Thus, by growing environmentally friendly trees, employing organic manure, and refraining from farming methods that contaminate the environment and expose the soil to erosion, the people of Sub-Saharan Africa should join the global fight for environmental sustainability.

Keywords: environmental sustainability, inclusive human development

1. Introduction

A major concern in Sub-Saharan Africa is environmental sustainability because of the region's great biodiversity, biological richness, and numerous communities' reliance on natural resources for subsistence. Sub-Saharan Africa does, however, also have several environmental issues that could seriously jeopardise sustainability. (Fonchamnyo & Nginyu, 2023; Adebayo, 2023)

Sub-Saharan Africa is a diverse continent with different nations and contexts have heterogeneous environmental concerns and sustainability initiatives. Governments, international organisations, local communities, and other stakeholders must work together to design and implement customised policies that take into account the particular requirements and conditions of each nation in order to address environmental sustainability (Fonchamnyo *et al.*, 2023).

The threat of global warming and climate change has attracted attention to the need for environmental sustainability and the fight against environmental degradation (Maji *et al.*, 2019). Moreover, even though most regions of the world have improved the welfare of their society over the past years, about 45% of Sub-Saharan Africans still live in extreme poverty (World Bank, 2014). Despite the efforts made to reduce extreme poverty, the region still hosts about half of the world's population that is socially excluded from basic amenities like potable water (Beegle *et al.*, 2016).

Like other developing countries, most of the people in the Sub-Sahara African region still live below the poverty line and are even more persistent than the other developing countries despite their rich endowment in natural resources (UNDP, 2016). Having made encouraging progress on the Millennium Deployment Goals (MDGs), African countries had the opportunity to use the newly launched sustainability deployment goals (SDGs) of 2012 to tackle the remaining challenges of the MDGs and achieve a development breakthrough by 2015 (Griggs, *et al.*, 2013; Haines & Cassels, 2004). Despite the encouraging results of the MDGs, countries in this region are still facing stagnation in economic performance as well as inclusive human development. According to the UNDP (2016), after a setback in human development in the first half of the 1990s, developed countries recovered strongly, while sub-Saharan Africa showed no sign of great improvement.

Despite efforts made to reduce extreme poverty, Sub-Saharan Africa still hosts about half of the world's population that is socially excluded from basic amenities like potable water (Beegle *et al.*, 2016). Human development in sub-Saharan Africa has remained stagnating while progressing in other parts of the world, widening their gap with the richest countries (UNDP, 2016). The HDR of 2015, found life expectancy in the region (sub-Saharan Africa) lower than 30 years ago (UNDP, 2015).

Research on the determinants of economic development has enjoyed an ample literature over the past decades. The need for inclusive human development has also attracted much attention in the literature (Asongu & Nwachukwu, 2016; Asongu & Odhiambo, 2019; Balan, 2016; Saboori *et al.*, 2012; Saboori *et al*., 2012; Asongu *et al.*, 2017; Chapman & Shigetomi, 2018). The list of these determinants is tremendously long, however, most if not all of them do not address the issue of inclusiveness, and therefore inequality is not taken into consideration when evaluating development. The appreciation of well-being is therefore inadequately tackled. According to the "inclusive human development" viewpoint, to appreciate development, it is important to take into consideration inequality both in achieving development and in enjoying the fruits of development, therefore not leaving out the poor. According to the UNDP (2018), Africa is the highest country that has a loss in human development due to inequality. More so Sub-Saharan Africa is losing around one-third of human development outcomes, higher than any other developing region, due to inequalities in health, education, and economic opportunities (UNDP, 2016). According to data from the World Bank, in 2020, 22 percent of children under the age of 5 worldwide (149.2 million) suffered from stunting. Between 2010 and 2019, the global primary and secondary school completion rates increased from 82 percent to 85 percent and from 46 percent to 53 percent, respectively. In sub-Saharan Africa, the primary completion rate rose from 57 percent in 2010 to 64 percent in 2019, while the secondary rate grew from 26 percent to 29 percent, leaving the region behind average.

According to the UNDP (2021), the impact of the coronavirus disease (COVID-19) pandemic has inverted much of the progress made to eradicate poverty, with global extreme poverty rising in 2020 for the first time since the Asian financial crisis of the late 1990s. Even before the pandemic, the world was not on track to achieve the goal of ending poverty by 2030, and without immediate and significant actions. Before the COVID-19 pandemic, the share of the world's population living in extreme poverty fell from 10.1 percent in 2015 to 9.3 percent in 2017.

The fruits of economic development from the growth revival have not been equitably distributed amongst the SSA population (Asongu *et al.*, 2018) and the growth process has been associated with more greenhouse gas emissions. Environmental degradation is a vital issue in the process of sustainable economic development because it has a negative effect on economic growth as well as human well-being (Azam, Does environmental degradation shackle economic growth? A panel data investigation on 11 Asian countries, 2016). The principal causes of water, land and air pollution, as well as global warming, are the consequence of enhanced and unrestrained human activities of economic growth and development, such as industries, agriculture, transportation and energy production (Ghosh, 2010). Economic, environmental as well as social issues are therefore interconnected. Emphasis should not only be laid on the development of present-day human welfare but the welfare of the future generations should also be taken into consideration. Environmental degradation hinders current growth as well as the future development (Azam, 2016).

The novelty of this study is threefold. Firstly, most of the existing studies on inclusive development are considered only the income dimension of well-being while those that considered the multidimensional aspect of well-being do not take into consideration the issue of inequality among the members of the society. This, therefore, explains the reason for the use of the inequality-adjusted human development. Secondly, the study employs the novel bio capacity which is a more comprehensive measure of environmental sustainability. Thirdly, the literature has mainly focused on the effect of economic development on environmental degradation and little attention is paid to the effect of these environmental damages on human well-being. The study, therefore, feels this gap by investigating the effect of environmental sustainability on inclusive human development.

The scope of this study is limited to 49 Sub-Saharan African countries from 2010 to 2017. The reasons adduced for limiting the scope to SSA are because (1) the region is the least in the global HDI rankings and (2) the region has the highest prevalence of poverty and inequality (Raheem, Isah, & Adedeji, 2016).

2. Literature Review

Why are some countries so rich and some other countries so poor? This is the fundamental question in macroeconomics. According to the convergence theory of economic development, less developed economies tend to grow more quickly than developed economies. The theory is based on the idea that the growth rate will slow as an economy approaches the steady state level of capital per worker. Absolute convergence predicts that poor countries will grow more quickly regardless of their eventual steady state steady-state put. The less developed countries have been found to grow very slowly, even less than the developed countries. Countries with relative equality and access to public education grew faster and were able to converge on countries with inequality and limited education (Sokoloff & Engerman, 2000). Environmental degradation is a result of every economic activity. Over the past several decades, the determinants of human development have attracted increasing attention in both theoretical and applied research, though the process underlying human development has been inadequately conceptualised. This can be attributed to the lack of a generalized or unifying theory as well as the myopic way economists approach this domain.

The nexus between economic development and environmental degradation has been a focus of environmentalists' inquiries for many years now. According to Yevdokimov *et al.* (2022), there are two opposing views regarding the effect of economic growth on environmental quality. The first one states that economic growth is detrimental to the environment due to inefficient use of resources, which leads to environmental degradation, while the second states that economic growth and technological progress improve environmental quality. The base for the analysis of the effect of economic growth on environmental quality is the environmental Kuznets curve (EKC) which shows an inverted U-shape relationship between pollution and per capita income. EKC hypothesis that there exists an inverted U-shaped relationship between environmental degradation and income per capita (Shafik, 1994; Dinda, 2004; Coondoo & Dinda, 2008; Ozcan et *al.*, 2020). The last stream of literature focuses on the effect of environmental degradation on economic growth. Environmental degradation has been found to hurt economic growth (Naeem, et al., 2021).

Nevertheless, most of the authors emphasize the fact that environmental degradation hinders human development. Arminen and Menegaki (2019) explored the causal relationships between energy consumption, economic growth and CO_2 emissions in upper-middle-income and high-income countries using a simultaneous equations modelling framework from 1985 to 2011. The results revealed a bidirectional causal relationship between GDP and energy consumption but do not provide any support to validate the EKC hypothesis. Therefore, upper-middle-income and high-income countries base their economic growth on a feedback relationship with energy consumption and the ensuing pollution has not yet reached a maximum point, even in the countries of study.

Rahmana *et al*. (2022) examined the pollution haven hypothesis in the Pakistan context over the period 1975 to 2016. By employing a NARDL approach, their empirical findings confirmed a symmetric association between FDI inflow and CO2 emissions in both the short and long run. In addition, agriculture had a positive and insignificant effect on CO2 emissions, whereas population growth and trade openness had a negative and significant effect on CO2 emissions in both the short and long run. Furthermore, while GDP per capita had a positive and significant, GDP per capita squared had a negative and significant on CO2 emissions in the short and long run, hence confirming the environmental Kuznets curve hypothesis. Their overall findings confirmed the applicability of both the EKC and pollution haven hypotheses in Pakistan.

Using different estimation techniques as well as different empirical settings, various views have been found by various researchers as to the relationship between FD and economic growth. For instance, Ögnificant effectztürk and Öz, (2016) found from a co-integration test and Granger causality analysis in Turkey for the period 1974-2011 that, there exists a unilateral causal relation from energy consumption to economic growth. Saboori *et al*. (2012) found from a Granger causality test based on the Vector Error Correction Model (VECM) for Malaysia from 1980 to 2009 that there exists no causation between CO2 emissions and economic growth in the short-run while validating a unidirectional causality from economic growth to CO2 emissions in the long-run. Naeem *et al.* (2021) found an insignificant effect of CO2 emissions on infants' health as captured by child mortality in Pakistan from 1975 to 2013. Using the ARDL Model, Ahmad et al. (2018) found that lowering Carbon dioxide emissions which is the principal cause of greenhouse gas emissions improves the quality of life for citizens in China over the period 1960 to 2014. Balan (2016) found that there exist causal relationships between health, education and environmental quality.

Bouchoucha (2021) investigated the relationship between environmental degradation, institutional quality and health in 17 MENA countries. They employed a panel cointegration analysis to determine the long-run relationship over the period 1996-2018, using both fully modified ordinary least square and a dynamic ordinary least square method. They found that environmental degradation affects negatively the health status in the long run in MENA countries. However, the effect of environmental degradation on health can be ameliorated through the presence of good institutional quality.

Ahmad *et al.* (2018) investigated the relationship between environmental quality variables, socioeconomic factors, and human health in China over the period 1960 to 2014, using ARDL Model. They used three main environmental quality indicators; carbon emissions from natural gas, coal, and petrol and two representative socio-economic factor variables; per capita income and urban population. The results validate the long-term negative effect of carbon emissions from the consumption of natural gas, coal, and petroleum on human health. The findings also reveal that migration from the countryside to cities and an increase in per capita income improve the quality of health. It is suggested that lowering the emission of CO2, which is the principal cause of greenhouse gas emissions, should be important in setting up a high quality of life for citizens.

Azam (2016) investigated the effect of environmental degradation proxied by CO_2 emissions on the economic growth of 11 Asian countries between 1990 and 2011. Based on the fixed effects and random effects employed, in which the results of Hausman's test showed that the use of fixed effects estimator is preferable over the random-effect estimator. Empirical results revealed that environmental degradation has a significantly negative impact on economic growth.

Fakhri *et al.* (2015) investigated the impact of CO_2 emissions on per capita growth, energy consumption, life expectancy and urbanisation in MENA countries (Algeria, Bahrain, Egypt, Emirates Arabs, Jordan, Saudi Arabs, Morocco, Qatar, Tunisia and Yemen) from 1990 to 2010. The empirical results have covered two-time horizons: the short and long term. Indeed, in the short term, we noticed for all countries of our sample, that the CO_2 emission is explained by energy consumption and economic growth per capita which exert positive and significant effects. However, we noticed that CO_2 emission is always positively influenced by energy consumption and negatively influenced by life expectancy. Also, the effect of income per capita was negative and significant which means that the long-term economic strategy of these countries is based on activities and non-polluting sectors. In other words, growth-generating economic potential are located in non-polluting sectors and not generators of greenhouse gas.

Much research has been centred around the issue of development. Many authors investigated the determinants of economic growth. The has been a great evolution in the literature from the move from evaluating well-being based just on the income dimension to a multidimensional aspect based on the income, health as well as the educational dimension which was termed human development. In the last decade, the ultimate goal was drifted to inclusive human development, development which is more centred around equity and not only development that advancing the well-being of the rich at the detriment of the poor. Nevertheless, development comes with its drawbacks as every blessing comes with its disappointment. As the world population continue to grow, the more the environment is being exploited to take care of the growing population. Most research did focus on the relationship between environmental sustainability and economic development. Nevertheless, little attention has been given to the effect of environmental sustainability on inclusive human development which is the value added of this study.

Despite the growing empirical research on the determinants of economic development, the literature seems to pay little attention to inequality. In this study, the inequality-adjusted human development is used as a likely and efficient inclusive human development (IHD). IHD is a broad concept which cannot be measured holistically. Based on the foregoing, this study seeks to empirically examine the possibility of achieving inclusive human development through an increase in environmental sustainability in Sub-Saharan Africa.

A greater proportion of the literature has used CO2 emissions to measure environmental quality (Abid, 2016; GANI, 2012; Sarkodie & Adams, 2018; Hunjra, Tayachi, Chani, Verhoeven, & Mehmood, 2020; Ali, et al., 2019; Adebayo, 2023). However, CO2 emissions is limited in that it's not possible to understand the total environmental damage it causes to the environment. More so, CO2 emissions represent only a small percentage of total environmental damage (Al-Mulali, Weng-Wai, Sheau-Ting, & Mohammed, 2015). Lu (2020) on his part argued that the use of air pollution in general and CO2 emissions in particular as the only determinants cannot adequately reflect environmental damage as it neglects other environmental degradation sources such as deforestation, agriculture and mining. The use of CO2 emissions as an indicator is poor; for it is a cause to environmental degradation and cannot adequately reflect environmental damage. It is therefore important to use a more comprehensive measure for environmental quality. In this context bio capacity which is a more comprehensive indicator of environmental sustainability has begun to be widely used in recent studies (Hassan, Baloch, Mahmood, Zhang, & others, 2019; Galli, et al., 2020; Wackernagel & Beyers, Ecological footprint: Managing our biocapacity budget, 2019). Biocapacity is the number of natural resources available at a specific moment in a particular place. Therefore, bio-capacity is an important indicator of environmental sustainability.

More so, regarding the relationship between economic development and the environment, the literature focuses only on the Kuznets curve which explores the effect of economic growth on the environment. Nevertheless, the effect of environmental degradation on human development which is the ultimate end of development seems to be lacking seems to be lacking behind. This study therefore uses the environmental bio-capacity and the inequality adjusted human development to investigate the effect of environmental degradation on inclusive human development in Sub-Sahara Africa.

3. Methodology

3.1 Model Specification

Due to a lack of data availability on environmental quality, evaluation of the quality of the environment was mainly focused on the causes of environmental degradation since the causes are highly correlated with the causes. For example, most works consider the emission of gases as a measure of environmental degradation though it's a cause. A greater proportion of the literature has used emissions to measure environmental quality (Abid, 2016; GANI, 2012; Sarkodie & Adams, 2018; Hunjra, Tayachi, Chani, Verhoeven, & Mehmood, 2020; Ali, et al., 2019; Adebayo, 2023). Authors like Cheng & Hu (2023), Kartal *et al.* (2023), Seri & de Juan Fernández (2023), Lee *et al.* (2023), Magazzino & Mele (2022), Zhao *et al.* (2021) used CO_2 emission to measure of environmental degradation. However, CO2 emissioare is limited in that it's not possible to understand the total environmental damage it causes to the environment. More so, CO_2 emission represents only a small percentage of total environmental damage (Al-Mulali, Weng-Wai, Sheau-Ting, & Mohammed, 2015).

Other authors used methane emission as a measure of environmental degradation. For example, Davamani *et al.* (2020) Miller *et al.* (2013), Hanif *et al*. (2022). Nevertheless, the critics of CO_2 emissions are same like that of methane emissions. Lu (2020) also argued that the use of air pollution in general and CO_2 emissions in particular as the only determinants cannot adequately reflect environmental damage as it neglects other environmental degradation sources such as deforestation, agriculture and mining. The use of CO_2 emissions as an indicator is poor; for it is a cause of environmental degradation and cannot adequately reflect environmental damage. Nevertheless, any authors have used gas emissions a measure of environmental quality (Rehman *et al.*, 2020; Yusuf *et al.*, 2020; Cheng *et al.*, 2022).

It has therefore been important to use a more comprehensive measure for environmental quality which focuses on evaluating environmental quality in itself rather than its causes. This explains why the author have been using a more comprehensive measure of environmental quality for the past years like the ecological footprint and biocapacity (Ozcan *et al.*, 2019). The ecological footprint created by Rees (1992) and Wackernagel and Rees (2004) measures the pressure humanity is exerting on the environment to satisfy their wants. According to the Global Footprint Network, (2017) it measures "the ecological assets that a given population requires to produce the natural resources it consumes (including plant-based food and fibre products, livestock and fish products, timber and other forest products, space for urban infrastructure) and to absorb its waste, especially carbon emissions". The environmental bio capacity of an ecosystem on the other hand is an estimate of the total productivity of the natural resources as well as its absorption and filtering capacity of other materials like carbon dioxide (Yue *et al.*, 2013).

In this context bio capacity, which is a more comprehensive indicator of environmental sustainability has begun to be widely used in recent studies (Galli, et al., 2020; Wackernagel & Beyers, 2019). This study therefore uses the novel bio capability and inequality-adjusted human development to measure environmental degradation and inclusive human development.

3.2 Model Specification

The present study investigates whether institutional quality has a statistically significant effect on inclusive human development. Based on the Tobin's (1955) dynamic aggregative production function highlights the role of resources in the growth process. The specification of our model is based on the inspiration of Asongu and Odhiambo (2019) Asongu and Odhiambo (2020) Asongu, *et al.* (2019) who argued that inclusive human development is a function of environmental quality.

IHDI=f (ES, IQ, TD, FI, DA) …………………………………….. (1)

Where IHDI=inclusive human development, ES= environmental sustainability, IQ= institutional quality index, TD=trade openness, FI=foreign direct investment, DA= official development assistant, Econometrically, the model can be specified s follows

$$IHDI_{it} = \alpha_1 + \alpha_2 ES_{it} + \alpha_3 IQ_{it} + \alpha_4 TD_{it} + \alpha_5 FI_{it} + \alpha_6 DA_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots\dots\dots\dots \quad (2)$$

Where ε_{it} is the error term and αi are parameters to be estimated i=1, 2….. N and t=1,2, ..T. Data for this study were collected from several sources which are all secondary. Data on inclusive human development was gotten from the united nations development program. Inclusive human development was therefore captured by the inequality-adjusted human development. More so, data on environmental sustainability which was measured by biocapacity was collected from the ecological footprint network. Institutional quality variables were gotten from World Governance indicated as proposed by Kaufmann *et al.* (2010). Lastly, the remainder of the variables were gotten from World Development Indicators. The institutional quality index was gotten by using the principal component analysis based on the six dimensions of institutional quality from the worldwide governance indicator (control of corruption, government effectiveness, political stability, regulatory quality, role of law, voice and accountability). These institutional quality variables will also be used to verify the stability of the result.

World governance indicators were used as a source of data for institutional quality variables because of theirs availability as well as reliability as most though not all researcherses use this data source for research (Goel, Herrala, & Mazhar, 2013; Sulaiman, Abdul-Rahim, Mohd-Shahwahid, & Chin, 2017; Yinusa, Aworinde, & Odusanya, 2020; Hunjra, Tayachi, Chani, Verhoeven, & Mehmood, 2020). More so, world governance indicators were also chosen as it takes into consideration the key dimensions of institutional quality.

It has therefore been important to use a more comprehensive measure for environmental quality which focuses on evaluating environmental quality in itself rather than its causes. This explains why we chose a more comprehensive measure of environmental quality for the past years like the ecological footprint and biocapacity (Ozcan *et al.*, 2019). In this context bio capacity, which is a more comprehensive indicator of environmental sustainability has begun to be widely used in recent studies (Hassan *et al.*, 2019; Galli, *et al.*, 2020; Wackernagel & Beyers, 2019). Biocapacity is the amount of natural resources available at a specific moment in a particular place. Therefore, bio-capacity is an important indicator of environmental sustainability.

Data for inclusive human development was obtained from UNDP. These sources of data were used for three reasons. Firstly, it's the only data source that takes into consideration the multi-dimensional nature of human development. Secondly, this is the only source of data on human development which takes into consideration not only the multi-dimension issues but inequality in the society and therefore the issue of inclusive human development is we tackled. Thirdly this data source is freely available for a good number of sub-Saharan African countries though for a short period of time. Other control variables were obtained from world development indicators. The key reason for the choice was due to availability and the absence of any financial cost.

3.3 Estimation Technique

To estimate the above mentioned model, we are going to employ the Generalised Method of Moments (GMM) estimation technique. The motivation for using GMMs is found in Arellano and Bond (1991) Blundell and Bond (1998) and later in Levine *et al.* (2000) who provided the rationality for using the GMM to study the relationship between variables. GMM corrects for endogeneity not only at the level of the other explanatory variables but also of the dependent variable by the use of a series of instrumental variables generated by the lag of the endogenous variables. Dynamic models are characterised by the presence of one or more lag values of the dependent variable among the explanatory variables. In this model, the presence of the lag-dependent variable does not make it possible to use econometric techniques such as ordinary least squares. As estimated results under the static panel models such as pooled OLS, fixed-effect, and random-effect estimators may lead to biased results in the presence of lagged dependent variables or potential endogeneity of explanatory variables (Ibrahim & Law, 2014), in light to these econometric issues, we adopt the system-GMM method of estimation in the analysis.

From the model specified above, if we consider an autoregressive panel data model of the form,

$$IHDI_{it} = \alpha_1 + \partial_1 IHDI_{it-1} + \alpha_2 ES_{it} + \partial_2 ES_{it-1} + \alpha_3 IQ_{it} + \partial_3 IQ_{it-1} + \alpha_4 TD_{it} + \partial_4 TD_{it} + \alpha_5 FI_{it} + \partial_5 FI_{it-1} + \alpha_6 DA_{it} + \partial_6 DA_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$where\ \varepsilon_{it}=\eta_i + \nu_{it}$ is the usual 'fixed effects' decomposition of the error term; N is large, T small as in our case. When we estimate the above model using the fixed effect and random effect estimators, the explanatory variables will be correlated with the error term which violets the assumption of exogeneity of the estimates. There are numerous methods of dynamic panel estimation among which we have GMM. The GMM estimator has several advantages because it is robust to model misspecification since its derivation does not require any particular distributional assumptions on the residuals. It is closer to the theoretical relation because this estimator is chosen so as to minimise the weighted distance between the theoretical values and the observed values.

There are two types of GMM; difference GMM estimator and system GMM estimator. After Arrelano and Bond (1991), the first difference GMM involves taking for each period the first difference of the equation to estimate to remove the specific effects of individuals and instrument thereafter the explanatory variables of first difference equation by their level values lag by one or more periods.

$$\Delta IHDI_{it} = \alpha_1 + \alpha_7 \Delta IHDI_{it-1} + \alpha_2 \Delta ES_{it} + \alpha_3 \Delta IQ_{it} + \alpha_4 \Delta TD_{it} + \alpha_5 \Delta FI_{it} + \alpha_6 \Delta DA_{it} + \varepsilon_{it} \ldots\ldots \quad (4)$$

The system GMM estimator by Blundell and Bond (1998) combines the first difference equations with the level equations and have been found to be more rebut than difference GMM.

4. Result and Discussion

Before the presentation of the regression results, it I was important to present the descriptive statistics of the variables employed.

Table 1. Descriptive statistics and correlation analysis

Variables	Obs	Mean	Std. Dev.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)

IHD	298	.343	.083	.208	.69	1.000					
ES	304	.085	.157	0	1	0.274	1.000				
IQn	312	.411	.199	0	1	0.559	-0.087	1.000			
TD	295	.381	.211	0	1	0.209	0.223	0.229	1.000		
FI	312	.107	.102	0	1	-0.066	0.064	0.008	0.370	1.000	
DA	312	.1	.103	0	1	-0.384	-0.134	-0.192	0.043	0.484	1.000

Source: Constructed by author from secondary data (2022).

From the table above, the sample size was 312 observations though some variables were missing variables and therefore our panel was not strongly balanced. The limitation of the sample size is because t data on inequality-adjusted human development was available just from 2010 to 2018 while data for bio capacity was not available after 2017. All the variables were normalised to fall within a minimum and maximum value of 0 and 1 respectively except the inequality adjusted human development index which was no more normalised since it and index between 0 and1.

Figure 1 also demonstrate the relationship between environmental sustainability and inclusive human development in Sub-Saharan Africa. The trend is divided into four trends, for the whole sample, lower income countries, lower middle income countries and finally, for the middle upper income countries. For the whole sample, the trend suggests that there is a positive relationship between environmental sustainability and inclusive human development. This shows that at higher levels of environmental sustainability, the level of inclusive human development is also high.

This relationship is found to vary across different income groups. In lower-income countries, the relationship between environmental sustainability and inclusive human development is negative. In the lower middle income countries there is no relationship between environmental sustainability and inclusive human development. On the other hand, middle upper income countries the relationship between environmental sustainability and inclusive human development turns to be positive. This therefore mean that the relationship between environmental sustainability and inclusive human development is no linear and turns to vary across income levels. Therefore, inclusive human development increases with a decrease in environmental sustainability until a certain threshold where this relationship turn to be positive. This is therefore in line with the EK curve which focuses on the demand side of the environment and explains that an increase in economic growth increases environmental degradation until a certain threshold of development where the increase in economic growth turns to reduce environmental degradation.

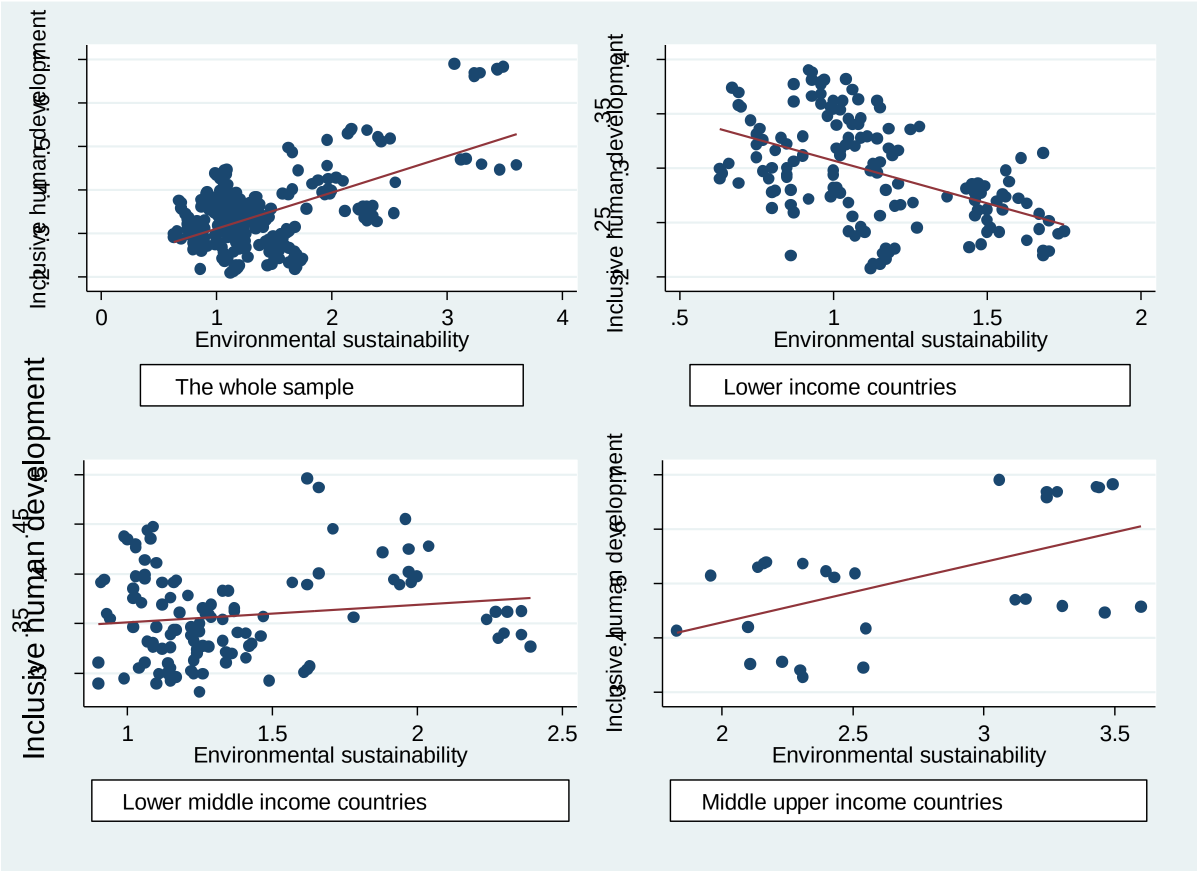

Figure 1. The relationship between environmental sustainability and inclusive human development

Source: Authors construction.

Before the analysis proper, was important to investigate the specification of our panel model, that is, if the model employed portrays homogenous or heterogeneity slopes across panels (Pesaran & Yamagata, 2008).

Table 2. Testing for slope heterogeneity

H0: slope coefficients are homogenous	
Delta (p-value)	1.010 (0.312)
adj. (p-value)	3.566 (0.000)

Source: Constructed by author from secondary data (2022).

The slope homogeneity test was done using the Pesaran and Yamagata (2008) slope homogeneity test of 2008. From the table above, the delta p-value is significant at 1% p-value. Therefore, the panel is heterogamous and therefore we can proceed with our panel estimation since the slope coefficients are heterogeneous across cross-sectional units.

Table 3 below presents the empirical results of the effect of environmental sustainability on inclusive human development in SSA. Column one of Table 3 presents the baseline model of effect of environmental sustainability on inclusive human development in SSA after which the different dimensions that were used to construct the institutional quality index are added alternatively to see the robustness of our results and to avoid multicollinearity since the institutional quality variables are highly correlated among themselves.

Table 3. The effect of environmental Sustainability on inclusive human development in SSA (two System GMM)

Dependent variable: inclusive human development

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Inclusive human development	0.8942***	0.9851***	0.9726***	0.9386***	0.9859***	0.9731***	0.9792***
	(0.0094)	(0.0053)	(0.0098)	(0.0106)	(0.0074)	(0.0089)	(0.0079)
Environmental sustainability	0.0083**	0.0059***	0.0118***	0.0082**	0.0067**	0.0088***	0.0091***
	(0.0039)	(0.0014)	(0.0031)	(0.0031)	(0.0025)	(0.0027)	(0.0029)
Trade	-0.0281***	-0.0149***	-0.0145***	-0.0235***	-0.0133**	-0.0120*	-0.0185***
	(0.0028)	(0.0046)	(0.0053)	(0.0074)	(0.0055)	(0.0063)	(0.0051)
Foreign direct investment	-0.0036	0.0166***	0.0111***	0.0060	0.0156***	0.0147***	0.0186***
	(0.0040)	(0.0038)	(0.0024)	(0.0044)	(0.0034)	(0.0037)	(0.0040)
Development assistant	-0.0789***	-0.0068	0.0046	-0.0323**	-0.0054	0.0036	-0.0106
	(0.0051)	(0.0105)	(0.0095)	(0.0132)	(0.0106)	(0.0095)	(0.0120)
Institutional quality	0.0316***						
	(0.0014)						
Control of corruption		0.0032					
		(0.0025)					
Government effectiveness			0.0241***				
			(0.0061)				
Political stability				0.0279***			
				(0.0059)			
Regulatory quality					0.0123**		
					(0.0058)		
Role of law						0.0219***	
						(0.0052)	
Voice and accountability							0.0076**
							(0.0032)
Constant	0.0473***	0.0144***	0.0104**	0.0224***	0.0094**	0.0092**	0.0158***
	(0.0025)	(0.0031)	(0.0038)	(0.0045)	(0.0042)	(0.0043)	(0.0037)
Observations	234	234	234	234	234	234	234
No of Countries	36	36	36	36	36	36	36
AR(1)	0.00171	0.00348	0.00314	0.00277	0.00340	0.00345	0.00308
AR(2)	0.440	0.393	0.377	0.395	0.383	0.391	0.392
Sargan OIR	0.167	0.0195	0.0235	0.0216	0.0236	0.0286	0.0218
Hansen OIR	0.370	0.494	0.465	0.284	0.465	0.419	0.385
FisherStat	1.061e+06	1.710e+07	9.268e+06	1.500e+07	5.250e+08	8.384e+06	3.975e+06
FisherP-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Constructed by author from secondary data (2022).

The baseline model presented in column 1 has as dependent variable inclusive human development and as independent variables the first lag of inclusive human development, environmental sustainability, trade openness, foreign direct investment net official development assistance and institutional quality. From column 2 to 7 the other variables remain the same while the institutional quality index is replaced by the different dimensions of institutional quality which were used to construct the institutional quality index are alternatively added since they are highly correlated, and to avoid multi-collinearity between the variables as earlier announced above.

From the results of the Arellano-Bond test for Autocorrelation of residuals and the Hansen (1982) and Sargan (1958) test of over-identification restrictions above, we found that; there is an absence of Autocorrelation of order one since its p-value was significant at 5% and presence of Autocorrelation of other two since its p-value was insignificant at 5%. To that which concerns the Hansen (1982) and Sargan (1958) test of over-identification restrictions, the instruments were valid since their p-value was insignificant at 5%. Therefore, the Hansen test failed to reject the over-identification, suggesting that we have a valid instrument and the serial correlation test failed to reject the null of the no AR (2) while rejecting the null of the no AR (1).

From the table above, the coefficient of the lagged of inclusive human development is 0.8942 and significant at 1%. It was found that the lagged values of inclusive human development have a positive and statistically significant effect on inclusive human development. This therefore implies that, increase in the pass value of inclusive human development by 1 point will increase the present value of inclusive human development by 0.8942 points. These results are stable even after mining our results with the different institutional quality variables.

As expected, the coefficient of environmental sustainability measured by bio capacity is positive and statistically significant at 1% with a coefficient of 0.0083. This means that if environmental sustainability increases by 1 point, inclusive human development will increase by 0.0083 points. These results are also remained stable even after adding a combination of other control variables. This result is statistically significant at 1% level which makes it relevant for policy recommendation towards improving inclusive human development. The outcome of this work is in line with the findings of Asongu *et al.* (2017) who claimed that Carbon dioxide degradation has a negative effect on inclusive human development in Sub Sahara African countries. It is also in line with the findings of Asongu and Odhiambo (2019), who found who had similar results in 44 sub-Saharan African countries.

More so, trade openness on the other hand was found to hurt inclusive human development with a coefficient of -0.0281. This means that if trade openness increases by one-point, inclusive human development will decrease by 0.0281 points significantly. These results are also stable even after mining with the different institutional quality variables though at different levels of significance. The results also reveal that foreign direct investment has a negative and statistically significant effect on inclusive human development with a coefficient of -0.0036. This means that if foreign direct investment increases by 1 point, inclusive human development will decrease by 0.0036 significantly. This result remains stable when the other dimensions of institutional quality are alternatively used in the place of institutional quality index except for regulatory quality when it becomes insignificant. The results also revealed that foreign aid has a negative and significant effect on inclusive human development with a coefficient of -0.0789. this means that if foreign aid increases by 1 point, inclusive human development will decrease by v points significantly. This result is significant at 1 % though becomes insignificant when the different dimensions of institutional quality are used except when regulatory quality is used. Regarding the effect of institutional quality on inclusive human development, it was found that institutional has a positive and statistically significant effect on inclusive development on inclusive human development with a coefficient of 0.0316. This means that if institutional quality increases by 1 point, inclusive human development will increase by 0.0316 points. In addition, all indicators of institutional quality were found to improve inclusive human development. However, control of corruption was not statistically significant.

5. Conclusion

Nowadays, it is obvious that inclusive human development is the intrinsic development goal that every member of the society participates in a country's development and also enjoys the fruit of development for it takes into consideration every member of the society. This study was designed to assess the effects of environmental sustainability on inclusive human development in Sub-Sahara Africa. To attain our objectives, data was analysed using system GMM on a sample of 49 Sub-Saharan Africa countries from 2010 to 2017. It was found that environmental sustainability improves inclusive human development in Sub-Sahara Africa throughout the study period.

It was therefore recommended that the population of Sub-Saharan African countries should participate in the inclusive fight for environmental sustainability by going for the planting of environmentally friendly trees, use of organic manure and stope the boning of farms which pollutes the environment and also exposes the soil to erosion. Although we document that environmental sustainability improves inclusive human development, we do not investigate the effect on the different dimensions of inclusive human development. We therefore suggest that, future research should investigate the effect of environmental sustainability on the different dimensions of inclusive human development to gate more insides for policy implications.

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