SAHEL INTERNATIONAL JOURNAL OF
ECONOMIC AND DEVELOPMENT STUDIES
Volume 1 | Issue 2 | July–December 2026

FOREIGN DIRECT INVESTMENT, ECONOMIC GROWTH AND ECOLOGICAL FOOTPRINT IN SUB-SAHARAN AFRICA: EVIDENCE FROM HETEROGENEOUS PANEL ARDL ESTIMATORS

Abubakar Saad Bahuli[1], Tijjani Mamman[2], Jummai Sabo Ogumka[3]
[1]Saad.bahuli@socsci.fulafia.edu.ng | [2]tmamman59@gmail.com | [3]jummaisabo0084@gmail.com
[1,2,3] Department of Economics, Federal University of Lafia, Nasarawa State, Nigeria
ORCID: 0009-0006-1592-7388 | 0009-0005-6488-9923
DOI: 10.64290/SIJEDS.v1i2.2

Abstract

Sub-Saharan Africa attracts growing foreign capital while its ecological footprint keeps rising. This study examines how foreign direct investment (FDI) and economic growth shape the ecological footprint of twelve Sub-Saharan African economies over 1990–2023, controlling for gross capital formation, urban population and institutional quality. Because the panel shows strong cross-sectional dependence and heterogeneous slopes, the analysis uses second-generation unit root tests, Kao and Westerlund cointegration tests, the pooled mean group (PMG), mean group and dynamic fixed effects estimators of the panel autoregressive distributed lag (ARDL) model, a cross-sectionally augmented ARDL robustness check and the Dumitrescu–Hurlin causality test. The variables are cointegrated and the Hausman test favours the PMG estimator. In the PMG long-run estimates, a 1% rise in income per capita is associated with a rise of about 0.23% in the ecological footprint, and a 1% rise in urban population with a rise of about 0.72%. No statistically significant conditional long-run association between FDI and the footprint is detected in this sample, so the estimates offer no support for either the pollution haven or the pollution halo hypothesis at the regional level, although the short-run FDI coefficient is negative and significant for the Democratic Republic of Congo. About 26% of any deviation from equilibrium is corrected within a year. On the finite-sample Dumitrescu–Hurlin statistic, past growth and urbanisation help predict the footprint, while FDI does not predict growth. The cross-sectionally augmented estimates preserve the absence of a significant FDI association but not the income and urbanisation effects, so these two results are best read as indicative. The evidence therefore points to the scale of growth and the pattern of urban expansion, more than to foreign capital, as the likely sources of ecological pressure, and policy should target the resource intensity of growth, urban land and energy systems, and the screening of FDI towards cleaner technology.

Keywords: *Ecological footprint; Foreign direct investment; Economic growth; Pooled mean group; Cross-sectional dependence; Sub-Saharan Africa*

JEL Classification: *F21; O44; O55; Q56; C33*

1. Introduction

The ecological footprint measures the biologically productive land and water that a population needs to produce what it consumes and to absorb its carbon waste, and it has become the most comprehensive single indicator of human pressure on nature [1, 2]. At the global level the picture is one of persistent overshoot. National footprint accounts show that humanity has demanded more than the Earth can regenerate every year since the 1970s, and that current demand is equivalent to about 1.7 planets [3, 4]. The consequences are visible in the decline of the living resource base: the monitored populations of vertebrate wildlife fell by 73% between 1970 and 2020, with a 76% fall in Africa [5, 6], while human influence has already warmed the planet by about 1.1 °C and placed the Paris targets at risk [7, 8]. Unlike carbon dioxide, which captures only one channel of degradation, the footprint adds cropland, grazing land, forest products, fishing grounds and built-up land, so it records pressure on the very assets on which low-income economies depend [9, 10].

Sub-Saharan Africa (SSA) occupies a distinctive position in this story. The region contributes only about 3.8% of global greenhouse gas emissions, yet its per capita footprint is rising faster than its biocapacity, deforestation exceeds 2% a year in some economies, and energy-related emissions have grown by more than 5% a year in the last decade [11–13]. Country evidence shows how the pressure builds. Nigeria's footprint already exceeds its biocapacity by about 58% [14, 15]; South Africa runs an ecological deficit driven by coal, mining and cities [16, 17]; rising emissions are already linked to lower life expectancy in Nigeria [18]; and in Benin the share of biologically active land around one expanding city fell from about 95% to 44% in three decades [19]. Urban growth is the fastest in the world, much of it unplanned, which converts forest and farmland into built-up land and locks in energy-intensive infrastructure [20–22]. At the same time, the region still relies heavily on biomass and fossil fuels [23, 24].

The twelve economies studied here mirror these trends. Between 1990 and 2023 their average ecological footprint per person rose by about 23%, from 1.28 to 1.58 global hectares, after peaking near 1.8 hectares around 2010; real income per person rose by about 53%; urban population more than tripled, from about 38 million to 126 million; and annual FDI inflows rose from about US$2.2 billion to US$12.4 billion, after a peak of more than US$20 billion in 2010. South Africa and Nigeria received about three quarters of the sample's FDI. These movements show that rising footprints have coincided with faster growth, urbanisation and foreign investment, but they do not reveal which of these forces drives the pressure, which is the question the econometric analysis addresses.

Two forces with clear links to this pressure are economic growth and foreign direct investment (FDI). Growth expands the scale of production and consumption; whether it eventually reduces pressure, as the environmental Kuznets curve (EKC) suggests, depends on changes in the composition of output and in technique [25, 26]. FDI brings capital and technology but may also relocate dirty production to economies with weaker regulation. FDI flows to Africa reached about US$53 billion in 2023 and rose to about US$97 billion in 2024, much of it in extractives, energy and infrastructure [27, 28], while African governments are seeking more private capital to close financing gaps [29, 30]. Foreign capital can therefore raise the footprint through scale and through investment in resource sectors, the pollution haven effect, or lower it through cleaner technology and management practices, the pollution halo effect [31–33]. Because FDI also affects growth [34, 35], the two forces cannot be studied in isolation.

The empirical evidence for SSA remains divided. Some studies report that FDI raises emissions or the footprint [36–39], others find that it improves environmental quality [40–42], and a third group finds no significant effect [43–45]. Three features of this literature motivate the present study. First, most African studies use carbon dioxide, which ignores land-based pressure where African economies are most exposed [46, 47]. Second, many apply estimators that assume homogeneous slopes and cross-sectional independence, although African economies share commodity price cycles and regional shocks and differ widely in structure [48, 49]. Third, few studies estimate the growth and FDI channels jointly while allowing short-run dynamics to differ across countries.

This study therefore asks three questions. Does FDI raise or reduce the ecological footprint of SSA in the long and the short run? How strongly does economic growth affect the footprint, and does the effect differ across countries? What is the direction of causality among FDI, growth and the footprint? It contributes in

three ways. It uses the ecological footprint for twelve SSA economies over 1990–2023 together with gross capital formation, urban population and institutional quality. It applies the PMG, mean group (MG) and dynamic fixed effects (DFE) estimators of the panel ARDL model after testing for cross-sectional dependence, slope heterogeneity, unit roots and cointegration, and checks the findings with a cross-sectionally augmented ARDL (CS-ARDL). It also reports country-specific adjustment speeds and short-run FDI effects, which allows the policy discussion to recognise differences across the region. The rest of the paper reviews the literature, presents the data and models, reports and discusses the results, and concludes.

2. Literature review

2.1 Theoretical framework

Three strands of theory guide the analysis. The EKC hypothesis holds that environmental pressure rises with income at early stages of development and declines after a turning point, as the composition of output shifts towards services and cleaner techniques are adopted [25]. Copeland and Taylor [26] decompose the effect of growth and openness into scale, composition and technique effects; for a low-income region dominated by primary production the scale effect is expected to dominate, as found for carbon emissions in SSA [50]. The pollution haven hypothesis predicts that foreign firms move pollution-intensive activities to economies with lax regulation, whereas the pollution halo hypothesis predicts that multinationals transfer cleaner technology and management standards [51, 52]. Finally, the STIRPAT framework [53] treats environmental impact as a multiplicative function of population, affluence and technology, which justifies a log-linear model with urban population, income, investment and institutions as determinants. Absorptive capacity theory adds that FDI benefits depend on local human capital and institutions [34, 54].

Applied to FDI, the same decomposition gives three channels. The scale channel raises output and resource use whatever the technology of the investor. The composition channel depends on where foreign capital goes: in SSA a large share has gone into oil, mining and agribusiness, which are land- and energy-intensive, while recent flows increasingly target services and renewable power [28, 55]. The technique channel works through the cleaner equipment, energy efficiency and environmental management systems that multinationals often bring [51, 56]. The net effect on the footprint is therefore an empirical question, and it may be small if the channels offset one another, as some African studies suggest [43, 45].

2.2 Conceptual framework

Figure 1 brings these theories together into the conceptual framework that guides the empirical model. The ecological footprint is the outcome. It is the demand that an economy places on six land types (carbon uptake land, cropland, grazing land, forest land, fishing grounds and built-up land), and it becomes an ecological deficit when it exceeds domestic biocapacity [1, 3]. Using the footprint rather than carbon dioxide matters for SSA, because most of the region’s pressure falls on land, forests and fisheries rather than on fossil emissions [13, 14]. Two core drivers act on this outcome, FDI and economic growth, and both do so through the same three transmission channels.

The scale channel is the most direct. More output requires more energy, materials and land, so growth and foreign capital both enlarge the footprint whatever the technology used [25, 26]. In SSA the scale channel is strong because growth is driven by mining, oil, commercial agriculture and construction, and because rising incomes raise household demand for food, charcoal, housing and transport [12, 50]. The composition channel depends on which sectors expand. When FDI and growth favour extraction and primary agriculture, the economy moves towards land- and energy-intensive activities and the footprint rises; when they favour services, telecommunications and renewable power, the footprint per unit of output falls [28, 57]. The technique channel works through the methods of production. Multinationals can bring cleaner equipment, energy-efficient processes and certified environmental management, and richer societies demand and can pay for stricter standards, both of which lower pressure [51, 52, 56]. The net effect of each driver is the sum of these channels. The pollution haven hypothesis corresponds to a dominant scale and composition effect of FDI, the halo hypothesis to a dominant technique effect, and a

 DOI: 10.64290/SIJEDS.v1i2.2

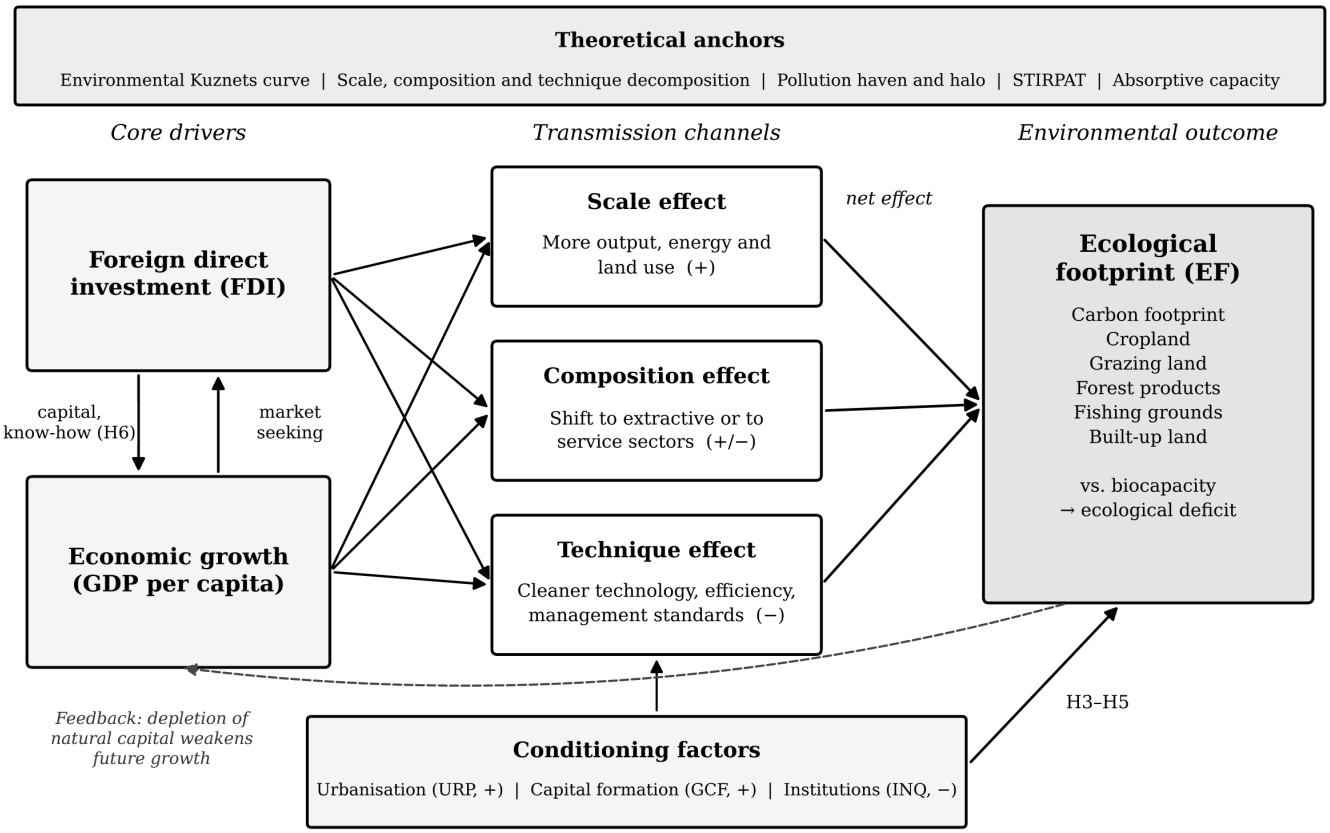
neutral FDI effect to channels that offset each other [33, 43].

The two drivers are also linked to each other. FDI supplies capital, technology and managerial skills that raise output, so it can affect the footprint indirectly through growth, while larger and faster-growing markets attract market-seeking FDI [34, 35, 54]. This two-way link is why the framework treats growth and FDI as jointly determined and why causality between them is tested. A feedback loop runs from the footprint back to growth: when demand exceeds biocapacity, soils, forests and fisheries are depleted and climate damage rises, which lowers the productivity of the natural capital on which agrarian and resource-based economies depend [2, 7].

Three conditioning factors shape the strength of these channels. Urbanisation converts farmland and forest into built-up land, raises the demand for fuel and imported food, and concentrates consumption, so it is expected to raise the footprint [20–22]. Gross capital formation adds to the stock of buildings, roads and machinery that use land and energy over long lives [58, 59]. Institutional quality governs the technique channel: strong regulation, contract enforcement and control of corruption allow governments to screen investment, enforce standards and price environmental damage, and so to turn the FDI effect from haven towards halo [38, 60, 61]. Following absorptive capacity theory, weak institutions limit the technology benefits of FDI [34].

The framework also has a time dimension. In the short run, the footprint responds to cyclical changes in output and to new investment projects, and the size of these responses differs across countries with different structures. In the long run, it settles on an equilibrium path determined by income, urban structure, capital stock, institutions and the type of foreign capital received. This distinction maps directly onto the error correction form of the panel ARDL model, in which short-run coefficients and adjustment speeds vary by country while long-run elasticities are shared [62]. From the framework, six testable hypotheses follow: H1, FDI affects the ecological footprint, positively under the haven effect and negatively under the halo effect; H2, economic growth raises the footprint through the scale effect; H3, urbanisation raises the footprint; H4, gross capital formation raises the footprint; H5, institutional quality lowers the footprint; and H6, FDI has predictive content for economic growth in the Granger sense. H1 to H5 are tested with the long-run coefficients of Equation (3), and H6 with the Dumitrescu–Hurlin test. Two points limit what these tests can show. Because the long-run model holds income constant, the FDI coefficient measures a conditional association that excludes any effect working through income. And pairwise Granger tests cannot establish that growth mediates an effect of FDI on the footprint, so H6 is a necessary condition for an indirect channel, not a test of mediation.

Figure 1: Conceptual framework linking FDI, economic growth and the ecological footprint



Note. Solid arrows show the hypothesised channels; the dashed arrow shows the feedback from ecological pressure to growth. Signs in brackets are the expected effects. H1 to H6 are the study hypotheses. Source: author's construction.

2.3 Economic growth and the ecological footprint

Recent evidence consistently finds a positive scale effect of growth on the footprint in Africa and other developing regions. Keho [47] reports that growth raises the footprint of West African economies using the CCEMG and AMG estimators, and Byaro [63] finds that growth increases the footprint of 19 SSA economies beyond the lowest quantiles. Similar positive effects are found for emerging and other developing economies [9, 64–66], and for African carbon emissions [12, 67, 68]. Evidence on the EKC is mixed: some African studies confirm an inverted U [22, 38, 69], others find an N shape [37] or reject the curve [68, 70, 71]. A minority finds that growth reduces the footprint [72], or that the effect is non-linear across income levels [60, 73]. Causality studies show that growth Granger-causes the footprint [74–76] and that feedback exists in some samples [21, 77]. Studies for Nigeria and South Africa confirm that growth, energy use and urbanisation raise the footprint [15, 16, 78, 79].

2.4 Foreign direct investment and the ecological footprint

Evidence on the environmental effect of FDI in Africa falls into three groups. Studies supporting the pollution haven hypothesis find that FDI raises emissions or the footprint in SSA and Africa [36–39, 57], in Nigeria [80], and in ECOWAS for the footprint [46]. Comparable effects appear in emerging economies [31, 32, 81, 82]. Studies supporting the halo hypothesis find that FDI reduces emissions or the footprint in SSA [40–42], in Nigeria [83], in West Africa [70] and elsewhere [52, 56, 84]. A third group finds weak or no effect: Tenaw [43] reports that FDI has no significant effect in the 20 largest African recipients, and machine learning and PMG studies reach the same conclusion for SSA and West Africa [44, 45, 85]. The effect also depends on institutions and on thresholds: FDI becomes harmful where governance is weak [60, 86, 87], and its effect differs between developing and developed hosts [33] and across time horizons [80, 88]. Causality evidence ranges from bidirectional links [89, 90] to one-way causality from FDI to the environment [41].

 DOI: 10.64290/SIJEDS.v1i2.2

Table 1 summarises selected recent studies on the region, which illustrate the absence of consensus on the direction of the FDI effect.

Table: Summary of selected recent empirical studies on SSA and Africa

Study	Sample	Method	Main finding
Abdul-Mumuni et al. [36]	41 SSA, 1996–2018	Panel NARDL	Positive FDI shocks raise CO2 (haven)
Achuo and Ojöng [37]	46 African, 1996–2022	Panel quantile regression	FDI raises CO2; N-shaped EKC
Jinapor et al. [38]	45 SSA, 2000–2019	Driscoll–Kraay	FDI harmful; institutions mitigate
Halliru et al. [46]	6 ECOWAS, 1970–2017	PMG	Haven for EF, halo for CO2
Duodu et al. [40]	23 SSA, 2005–2019	System GMM	FDI improves environmental quality in the long run
Yeboah et al. [41]	SSA panel	FMOLS, DOLS	FDI reduces CO2
Tenaw [43]	20 African, 1990–2017	CS-ARDL	No significant FDI effect
Dibba et al. [45]	16 West African, 1990–2023	PMG	No long-run FDI effect; EKC holds
Okere and Ambe [86]	18 SSA, 1996–2023	ARDL	FDI insignificant without institutional interaction
Keho [47]	West Africa, 1990–2018	CCEMG, AMG	Growth raises EF
Byaro [63]	19 SSA, 2000–2022	KRLS	Growth raises EF above the lowest quantiles
Pata and Pata [72]	5 African, 2006–2020	Regularised CCE	Growth reduces EF

Note. EF = ecological footprint; EKC = environmental Kuznets curve.

2.5 Control variables

Capital formation expands the physical stock that uses energy and land, and recent studies find that it raises the footprint [58, 59, 64]. Urbanisation raises demand for land, energy and materials, and most African studies find that it increases environmental pressure [21, 22, 91, 92], although some find a negative or insignificant effect [68]. Institutional quality may reduce pressure by enforcing regulation [38, 61, 93], but several studies find that governance indicators raise the footprint where growth is resource-led [94, 95]. Related work on FDI and growth in SSA shows that FDI raises growth [96–99], which creates an indirect environmental channel. Other studies examine green growth, renewable energy, finance and globalisation as drivers of environmental quality in Africa and comparable panels [100–108].

2.6 Research gap

The review shows that the FDI–footprint relationship in SSA is unsettled, that most African studies use carbon dioxide rather than the footprint, and that studies rarely combine the growth and FDI channels in a dynamic heterogeneous framework that tests for cross-sectional dependence. The present study fills this gap.

3. Data and methodology

3.1 Data and variables

The study uses an annual balanced panel of twelve SSA economies over 1990–2023 (N = 12, T = 34, 408 observations): Angola, Benin, Botswana, the Democratic Republic of Congo, Equatorial Guinea, Lesotho, Mauritania, Namibia, Nigeria, São Tomé and Príncipe, Sierra Leone and South Africa. The sample covers oil exporters, mineral exporters and small agrarian economies across West, Central and Southern Africa, and its length is suited to dynamic heterogeneous panel estimators that need a long time dimension. Table 2 describes the variables, drawn from the National Footprint and Biocapacity Accounts and the World Bank databases [4, 109]. FDI net inflows can be negative, so the study uses the inverse hyperbolic sine of FDI in US$ million, which is defined for negative values and approximates the natural logarithm for large values. The labour force series in the dataset is excluded because it is highly correlated with gross capital formation (r = 0.75) and adds parameters that the country-by-country regressions cannot support.

The construction of each series is as follows. The ecological footprint is the per capita footprint of consumption in global hectares from the 2023 edition of the National Footprint and Biocapacity Accounts [4]; this edition reports national values up to 2022, and the 2023 values are [obtained from the 2025 edition / projected from the 2018–2022 trend; the authors to state which]. From the World Development Indicators [109], accessed in [month, year], FDI is net inflows in current US$ (indicator BX.KLT.DINV.CD.WD), income is GDP per capita in constant 2015 US$ (NY.GDP.PCAP.KD), gross capital formation is in constant 2015 US$ (NE.GDI.TOTL.KD) and urban population is the number of urban residents (SP.URB.TOTL). Because income is measured at constant prices, its coefficient can be read as a real income elasticity. Institutional quality is the simple unweighted average of the six Worldwide Governance Indicators (voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption), each kept on its original scale of about −2.5 to 2.5. The governance indicators begin in 1996 and were published every second year until 2002. Values for 1997, 1999 and 2001 are linear interpolations between adjacent years, and values for 1990–1995 are set equal to the 1996 value for each country. No other observations are missing [or: list the country-years and the method used to fill them]. The panel is therefore balanced by construction, and Section 6.4 discusses what the constructed governance values imply for inference.

Table 2: Description, Measurement and Sources of Data

Variable	Symbol	Measurement	Source	Expected sign
Ecological footprint	EF	Global hectares per person (log)	Global Footprint Network	Dependent
Foreign direct investment	FDI	Net inflows, current US$ million (inverse hyperbolic sine)	World Bank, WDI	+ (haven) / − (halo)
Economic growth	GDP	GDP per capita, constant 2015 US$ (log)	World Bank, WDI	+
Gross capital formation	GCF	Gross capital formation, constant 2015 US$ (log)	World Bank, WDI	+
Urban population	URP	Urban population, persons (log)	World Bank, WDI	+
Institutional quality	INQ	Average of six WGI estimates (level)	World Bank, WGI	−

Note. Annual data for 12 SSA countries, 1990–2023 (408 observations). WDI codes: FDI, BX.KLT.DINV.CD.WD; GDP, NY.GDP.PCAP.KD; GCF, NE.GDI.TOTL.KD; URP, SP.URB.TOTL. WGI values for 1990–1995, 1997, 1999 and 2001 are constructed as described in Section 3.1.

3.2 Model specification

Following the STIRPAT framework [53], environmental impact is a multiplicative function of population, affluence and technology:

$$I_{it} = a\, P^{b}_{it}\, A^{c}_{it}\, T^{d}_{it}\, e_{it} \quad (1)$$

Extending affluence to income and investment, and technology to foreign capital and institutions, the ecological footprint is written as

$EF_{it} = f(FDI_{it}, GDP_{it}, GCF_{it}, URP_{it}, INQ_{it})$ (2)
and in log-linear form as

$\ln EF_{it} = \beta_{0i} + \beta_1 \ln FDI_{it} + \beta_2 \ln GDP_{it} + \beta_3 \ln GCF_{it} + \beta_4 \ln URP_{it} + \beta_5 INQ_{it} + \varepsilon_{it}$ (3)
where i = 1, …, N and t = 1, …, T. The pollution haven hypothesis implies $\beta_1 > 0$ and the halo hypothesis $\beta_1 < 0$; the scale effect implies $\beta_2 > 0$. To capture dynamics, Equation (3) is embedded in an ARDL(p, q) model [62]:

$\ln EF_{it} = \Sigma^{p}_{j=1} \lambda_{ij} \ln EF_{i,t-j} + \Sigma^{q}_{j=0} \delta'_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it}$ (4)
where X_{it} is the vector of regressors. Reparameterising gives the error correction form

$\Delta \ln EF_{it} = \varphi_i(\ln EF_{i,t-1} - \theta'_i X_{it}) + \Sigma^{p-1}_{j=1} \lambda^{*}_{ij} \Delta \ln EF_{i,t-j} + \Sigma^{q-1}_{j=0} \delta^{*\prime}_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it}$ (5)
with $\varphi_i = -(1 - \Sigma\lambda_{ij})$ the speed of adjustment and $\theta_i = \Sigma\delta_{ij}/(1 - \Sigma\lambda_{ij})$ the long-run coefficients. A negative and significant φ_i confirms a long-run relationship. Given T = 34 and five regressors, the study uses a common ARDL(1,1,1,1,1,1) structure, so the estimated model is

$\Delta \ln EF_{it} = \varphi_i[\ln EF_{i,t-1} - \theta_1 \ln FDI_{it} - \theta_2 \ln GDP_{it} - \theta_3 \ln GCF_{it} - \theta_4 \ln URP_{it} - \theta_5 INQ_{it}] + \gamma_{1i} \Delta \ln FDI_{it} + \gamma_{2i} \Delta \ln GDP_{it} + \gamma_{3i} \Delta \ln GCF_{it} + \gamma_{4i} \Delta \ln URP_{it} + \gamma_{5i} \Delta INQ_{it} + \mu_i + \varepsilon_{it}$ (6)
Three estimators are compared. The MG estimator fits Equation (6) country by country and averages the coefficients. The PMG estimator [62, 110] restricts the long-run coefficients to be equal across countries ($\theta_i = \theta$) while leaving intercepts, adjustment speeds, short-run coefficients and error variances free, and is estimated by maximum likelihood. The DFE estimator imposes common slopes in both horizons. The Hausman test [111] selects between them.

The panel ARDL approach suits the data for three reasons. It is valid when regressors are a mixture of I(0) and I(1) series, provided none is I(2) [62]. It is designed for panels in which T is large relative to N, whereas difference and system GMM estimators are built for short panels and become unreliable when T exceeds N and instruments proliferate. And it separates long-run equilibrium relationships, which economic theory can restrict to be common across countries, from short-run adjustment, which differs with each country's economic structure, policy and exposure to shocks [33, 110].

3.3 pre-estimation tests

Cross-sectional dependence is tested with the CD statistic of Pesaran [48]:

$CD = [2T / N(N - 1)]^{1/2} \Sigma^{N-1}_{i=1} \Sigma^{N}_{j=i+1} \hat{\rho}_{ij}$ (7)
where $\hat{\rho}_{ij}$ is the pairwise correlation of the series. Slope homogeneity is tested with the delta statistics of Pesaran and Yamagata [112, 113]:

$\tilde{\Delta} = N^{1/2}(N^{-1}\tilde{S} - k)/(2k)^{1/2}$, $\tilde{\Delta}_{adj} = N^{1/2}(N^{-1}\tilde{S} - k)/[2k(T - k - 1)/(T + 1)]^{1/2}$ (8)
where $\tilde{S}$ is the weighted dispersion of the country estimates around the weighted fixed effects estimate. Because dependence is present, unit roots are tested with the cross-sectionally augmented IPS (CIPS) test [114], which averages the t-statistics $\hat{b}_i$ of the CADF regressions

$\Delta y_{it} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + \Sigma^{p}_{j=0} d_{ij} \Delta \bar{y}_{t-j} + \Sigma^{p}_{j=1} e_{ij} \Delta y_{i,t-j} + u_{it}$, $CIPS = N^{-1}\Sigma^{N}_{i=1} t_i$ (9)
Cointegration is tested with the Kao residual test [115] and the error-correction tests of Westerlund [116, 117], based on

$\Delta y_{it} = c_i + \alpha_i(y_{i,t-1} - \beta'_i x_{i,t-1}) + \Sigma^{p}_{j=1} \alpha_{ij} \Delta y_{i,t-j} + \Sigma^{p}_{j=0} \gamma'_{ij} \Delta x_{i,t-j} + e_{it}$ (10)
where the group-mean statistics G_τ and G_α and the panel statistics P_τ and P_α test H_0: $\alpha_i = 0$ for all i.

3.4 Robustness and causality

Because the PMG estimator does not remove common factors, the long-run results are checked with the CS-ARDL estimator [49, 118], which augments each country regression with cross-sectional averages $\bar{Z}_t$ of all variables and their first lag:

$\ln EF_{it} = c_i + \lambda_i \ln EF_{i,t-1} + \Sigma^{1}_{l=0} \delta'_{il} X_{i,t-l} + \Sigma^{1}_{l=0} \psi'_{il} \bar{Z}_{t-l} + e_{it}$, $\theta_{CS} = N^{-1}\Sigma_i(\delta_{i0} + \delta_{i1})/(1 - \lambda_i)$ (11)
Causality is tested with the Dumitrescu–Hurlin procedure [119, 120], which allows heterogeneous coefficients:

$y_{it} = \alpha_i + \Sigma^{K}_{k=1} \gamma_{ik} y_{i,t-k} + \Sigma^{K}_{k=1} \beta_{ik} x_{i,t-k} + \varepsilon_{it}$, $\bar{Z} = (N/2K)^{1/2}(\bar{W} - K)$ (12)

where $\bar{W}$ is the average of the individual Wald statistics. The test is applied to first differences with one lag. The estimations are implemented with the Stata 17 commands listed in Appendix A.

4. Results

4.1 Descriptive statistics and correlation

Table 3 shows wide differences across the panel. The mean footprint is 1.55 global hectares per person, with a range from 0.03 to 8.45, and real income per capita ranges from US$280 to US$14,223. FDI is highly volatile, with negative net inflows in some years and a kurtosis above 100, which supports the inverse hyperbolic sine transformation. After transformation the distributions are much closer to normal. Table 4 shows that the footprint is most strongly correlated with income (r = 0.81). The regressors are weakly correlated with one another, and all variance inflation factors are below 1.2, so multicollinearity is not a concern.

Table 3: Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min.	Max.	Skewness	Kurtosis
EF (gha per capita)	408	1.55	2.02	0.03	8.45	2.00	6.00
FDI (US$ million)	408	820.84	2,767.71	−7,397.00	41,300.00	8.20	115.15
GDP per capita (US$)	408	2,577.10	2,463.70	280.35	14,222.55	1.92	7.51
GCF (US$ million)	408	12,712.92	20,076.18	0.01	83,120.00	1.78	4.99
URP (thousand)	408	7,261.75	19,457.33	0.03	116,965	3.74	17.12
INQ (index)	408	−0.66	0.74	−2.55	1.79	0.62	4.23
lnEF	408	−0.35	1.40	−3.52	2.13	−0.44	2.83
lnFDI	408	4.49	4.26	−9.60	11.32	−1.47	4.84
lnGDP	408	7.45	0.92	5.64	9.56	0.05	2.15
lnGCF	408	20.95	3.89	9.21	25.14	−1.98	6.64
lnURP	408	12.47	4.29	3.42	18.58	−1.19	3.27

Note. The upper panel reports variables in levels and the lower panel the transformed series used in estimation.

Table 4: Correlation matrix and variance inflation factors

Variable	lnEF	lnFDI	lnGDP	lnGCF	lnURP	INQ	VIF	1/VIF
lnEF	1.000						–	–
lnFDI	0.183	1.000					1.10	0.91
lnGDP	0.813	0.175	1.000				1.11	0.90
lnGCF	0.267	0.240	0.291	1.000			1.14	0.88
lnURP	−0.049	−0.127	0.007	0.016	1.000		1.02	0.98
INQ	−0.022	0.007	−0.003	−0.000	0.018	1.000	1.00	1.00

Note. VIF = variance inflation factor from the regression of each regressor on the others.

4.2 Cross-sectional dependence and slope heterogeneity

Table 5 shows that the CD test rejects cross-sectional independence for the footprint, FDI, income, capital formation and urban population at the 1% level. The average absolute correlation ranges from 0.31 for FDI to 0.69 for income, which reflects common commodity, financial and climate shocks. Only institutional quality is cross-sectionally independent. The delta tests strongly reject slope homogeneity, so the response of the footprint to its determinants differs across countries. These results rule out estimators that assume independence and identical slopes, and they justify the heterogeneous panel ARDL framework and the second-generation tests.

Table 5: Cross-sectional dependence and slope homogeneity tests

Variable	CD statistic	p-value	Mean ρ	Mean |ρ|
lnEF	9.306***	<0.001	0.196	0.571
lnFDI	8.252***	<0.001	0.174	0.305
lnGDP	24.225***	<0.001	0.511	0.692
lnGCF	23.553***	<0.001	0.497	0.556
lnURP	31.532***	<0.001	0.666	0.677
INQ	0.221	0.825	0.005	0.119
Slope homogeneity	Statistic	p−value		
Δ˜	18.938***	<0.001		
Δãdj	21.173***	<0.001		

*Note. CD test [48] under the null of weak cross-sectional dependence; Δ̃ tests [112] under the null of slope homogeneity. *** p<0.01.*

4.3 Unit root and cointegration tests

Table 6 reports CIPS statistics with critical values simulated for this panel (N = 12, T = 34). With one lag, the footprint, income, capital formation and urban population are non-stationary in levels, whereas FDI and institutional quality are stationary. All variables are stationary in first differences, with urban population significant at the 10% level with one lag and at the 1% level without lags. The variables are therefore a mixture of I(0) and I(1), with none I(2), which is the case for which the panel ARDL approach is designed [62].

Table 6: CIPS panel unit root tests Result

Variable	Level, p = 0	Level, p = 1	First difference, p = 0	First difference, p = 1	Order
lnEF	−1.969	−1.774	−5.534***	−4.296***	I(1)
lnFDI	−3.198***	−2.942***	−5.991***	−4.808***	I(0)
lnGDP	−1.810	−2.067	−5.056***	−3.887***	I(1)
lnGCF	−2.102	−1.929	−5.649***	−3.868***	I(1)
lnURP	−3.202***	−1.970	−3.547***	−2.170*	I(1)
INQ	−4.480***	−3.519***	−6.190***	−5.399***	I(0)
5% critical value	−2.301	−2.279	−2.273	−2.253	

*Note. p is the augmentation lag. Critical values are simulated for N = 12 and T = 34 (2,000 replications under the unit root null, seed 12345; the simulation code is in Appendix A). Individual CADF statistics are truncated as in [114]. ** p<0.01, p<0.05, p<0.1.*

Table 7 shows that all five Kao statistics reject the null of no cointegration at the 1% level. Three of the four Westerlund statistics (G_α, P_τ and P_α) also reject the null at the 1% level, while the group-mean G_τ does not. Together with the negative and significant error correction terms reported below, the evidence supports a long-run relationship among the footprint, FDI, income, capital formation, urban population and institutional quality.

Table 7: Panel cointegration tests Result

Test / statistic	Statistic	p-value
Kao test		
Dickey–Fuller ρ (DFρ)	−5.940***	<0.001
Dickey–Fuller t (DFt)	−4.051***	<0.001
Modified Dickey–Fuller ρ (DF*ρ)	−12.730***	<0.001
Modified Dickey–Fuller t (DF*t)	−4.378***	<0.001
Augmented Dickey–Fuller t	−4.374***	<0.001
Westerlund test		
Gτ	−2.365	0.235
Gα	−64.271***	0.001
Pτ	−18.097***	<0.001
Pα	−131.057***	<0.001

*Note. H0: no cointegration. Kao test with one lag and demeaned data. Westerlund tests with a constant, one lag and no leads; bootstrap p-values from 1,000 replications (seed 12345). The bootstrap resamples whole time periods for all countries together, which keeps the cross-sectional correlation in the data intact [116, 117]. *** p<0.01.*

4.4 Long-run and short-run estimates

Table 8 reports the PMG, MG and DFE estimates. The Hausman test does not reject the PMG restriction against the MG estimator at the 5% level ($\chi^2(5) = 9.43$, $p = 0.093$) and rejects the DFE estimator in favour of PMG ($\chi^2(5) = 58.83$, $p < 0.01$), so the discussion focuses on the PMG estimates. The CD statistic on the PMG residuals (0.53, $p = 0.593$) shows that the model leaves no significant cross-sectional dependence in the residuals.

In the long run, real income per capita has a positive and significant effect: a 1% increase in income is associated with a 0.23% rise in the ecological footprint. Urban population has the largest estimated elasticity in this specification, with a 1% rise associated with a 0.72% rise in the footprint, although Section 4.5 shows that this estimate is not robust to unobserved common factors. The FDI coefficient is positive but close to zero (0.001, standard error 0.0054) and insignificant. No statistically significant conditional long-run association between FDI and the footprint is detected in this sample. This is a failure to reject a zero coefficient, not evidence that the effect is zero, although the 95% confidence interval (−0.010 to 0.012) is narrow enough to rule out large effects in either direction. Because income, investment and urbanisation are held constant, the coefficient also excludes any effect of FDI that works through these variables. Gross capital formation and institutional quality are negative but insignificant. The error correction term is −0.265 and significant at the 1% level, so about 26.5% of a deviation from long-run equilibrium is corrected each year, a half-life of about 2.3 years. In the short run, none of the averaged coefficients is significant at 5%, which is typical when short-run responses differ in sign across countries. The MG estimates have the same sign for income but are imprecise, as expected when twelve country regressions are averaged. The DFE estimator, which the Hausman test rejects, gives a small positive long-run FDI effect and a negative short-run effect.

Table 8: Panel ARDL(1,1,1,1,1,1) estimates Result

Dependent variable*:* Ecological Footprint ΔlnEF

VARIABLES	(1) PMG	(2) MG	(3) DFE
Long run			
lnFDI	0.0010	−0.0376	0.0448**
	(0.0054)	(0.0273)	(0.0217)
lnGDP	0.2327***	0.4447	0.5422***
	(0.0850)	(1.5567)	(0.1658)
lnGCF	−0.0362	0.6834	0.2607**
	(0.0335)	(0.4567)	(0.1174)
lnURP	0.7163***	−1.9858	−0.2085

 DOI: 10.64290/SIJEDS.v1i2.2

VARIABLES	(1) PMG	(2) MG	(3) DFE
	(0.0771)	(2.0591)	(0.1484)
INQ	−0.0228	0.0081	−0.0370
	(0.0241)	(0.0750)	(0.1080)
Short run			
ECT	−0.2648***	−0.5045***	−0.2167***
	(0.0733)	(0.0691)	(0.0309)
ΔlnFDI	−0.0034	0.0017	−0.0158***
	(0.0062)	(0.0087)	(0.0043)
ΔlnGDP	0.5808	0.6865	0.0376
	(0.3891)	(0.5006)	(0.1306)
ΔlnGCF	−0.1339	−0.3066*	−0.1080**
	(0.1289)	(0.1771)	(0.0525)
ΔlnURP	−2.0943	−0.5102	0.0237
	(2.1736)	(0.5863)	(0.0287)
ΔINQ	0.0119	0.0076	0.0048
	(0.0146)	(0.0192)	(0.0189)
Constant	−2.6519***	−2.7333	−1.6105***
	(0.8620)	(2.3525)	(0.1789)
Observations	396	396	396
Countries	12	12	12
Log likelihood	333.81		
Hausman $\chi^2(5)$		9.43 [0.093]	58.83 [<0.001]
CD (residuals)	0.534 [0.593]		

*Note. Standard errors in parentheses; p-values in brackets. ** p<0.01, p<0.05, p<0.1. The MG column Hausman statistic tests MG against PMG; the DFE column tests PMG against DFE.*

Table 9 reports the country-specific short-run estimates from the PMG model. The adjustment coefficient is negative and significant at 5% in five countries (Democratic Republic of Congo, Equatorial Guinea, São Tomé and Príncipe, Mauritania and Sierra Leone) and at 10% in Botswana and Namibia; it is insignificant in Nigeria, South Africa, Benin, Lesotho and Angola, where the footprint adjusts slowly. Short-run FDI effects are mostly small. FDI significantly lowers the footprint in the Democratic Republic of Congo and has weakly significant positive effects in Angola and São Tomé and Príncipe and a weakly negative effect in Namibia.

Table 9: Country-Specific Short-Run PMG Estimates Result

Country	ECT	SE	ΔlnFDI	SE	ΔlnGDP	SE
Angola	0.0799	(0.0617)	0.0052*	(0.0027)	−0.1326	(0.2782)
Benin	−0.0692	(0.0513)	0.0082	(0.0084)	4.4913**	(2.1459)
Botswana	−0.1582*	(0.0910)	0.0059	(0.0095)	0.8973**	(0.4372)
DR Congo	−0.2677***	(0.0770)	−0.0648***	(0.0154)	0.8041	(0.5802)
Equatorial Guinea	−0.7324***	(0.1984)	−0.0174	(0.0258)	1.3245**	(0.5711)
Lesotho	−0.1565	(0.1190)	0.0026	(0.0104)	0.0209	(0.1201)
Mauritania	−0.6937***	(0.1655)	−0.0016	(0.0027)	−0.1615	(0.3128)
Namibia	−0.2927*	(0.1558)	−0.0071*	(0.0037)	0.2293	(0.3376)
Nigeria	−0.0122	(0.0314)	0.0147	(0.0246)	−0.2436	(0.4479)
Sierra Leone	−0.4919***	(0.1594)	−0.0033	(0.0136)	0.4320	(0.3605)
South Africa	−0.1856	(0.1343)	−0.0007	(0.0033)	−0.5394	(0.4815)
São Tomé and Príncipe	−0.1980**	(0.0863)	0.0178*	(0.0101)	−0.1529	(0.1285)

*Note. Estimates from the PMG model in Table 9. ** p<0.01, p<0.05, p<0.1.*

4.5 Robustness: CS-ARDL estimates

Table 10 reports the CS-ARDL estimates, which control for unobserved common factors. The FDI coefficient remains positive and insignificant (0.0039, p = 0.841), so the absence of a significant FDI association survives the control for common factors. The other long-run results are less stable. The income coefficient stays positive but loses significance (1.0670, p = 0.228), and the urban population coefficient changes sign, from 0.7163 and significant under PMG to −1.6132 and insignificant (p = 0.628). The CS-ARDL check therefore supports the FDI result only and does not confirm the income and urbanisation findings. The change may reflect shared trends that the cross-sectional averages absorb, and the loss of precision when each of twelve short country regressions is augmented with averages, but the data cannot separate these explanations. The error correction coefficient (−0.75) is negative and significant, and institutional quality has a significant negative short-run effect. The CD statistic on the CS-ARDL residuals (−1.72, p = 0.085) does not reject weak cross-sectional dependence at the 5% level but does reject it at the 10% level, so some residual dependence may remain.

Table 10: Robustness check: CS-ARDL mean group estimates Result

VARIABLES	Coefficient	SE	p-value
Long run			
lnFDI	0.0039	(0.0196)	0.841
lnGDP	1.0670	(0.8850)	0.228
lnGCF	0.0890	(0.2733)	0.745
lnURP	−1.6132	(3.3298)	0.628
INQ	−0.0768	(0.0728)	0.292
Short run			
ΔlnFDI	−0.0038	(0.0065)	0.566
ΔlnGDP	0.8516	(0.6180)	0.168
ΔlnGCF	−0.1382	(0.1416)	0.329
ΔlnURP	−2.9305	(2.1929)	0.181
ΔINQ	−0.0620***	(0.0228)	0.007
ECT	−0.7451***	(0.1227)	<0.001
Observations	396		
Countries	12		
CD (residuals)	−1.720		0.085

*Note. Each country regression includes cross-sectional averages of all variables and their first lag. ** p<0.01, p<0.05, p<0.1.*

4.6 Dumitrescu–Hurlin causality

Table 11 reports the Dumitrescu–Hurlin results. With T = 34 and one lag, the finite-sample statistic $\tilde{Z}$ has better size properties than the asymptotic $\bar{Z}$ [119], so all decisions use $\tilde{Z}$ at the 5% level, a rule fixed before the results were read; $\bar{Z}$ is shown for completeness only. On this rule, past changes in income ($\tilde{Z}$ = 2.337, p = 0.019) and in urban population ($\tilde{Z}$ = 5.689, p < 0.001) help predict changes in the footprint, and there is no predictive content in the reverse direction. Capital formation does not predict the footprint ($\tilde{Z}$ p = 0.164), and the footprint does not predict institutional quality ($\tilde{Z}$ p = 0.146). There is no predictive relationship in either direction between FDI and the footprint, and FDI does not predict income growth ($\tilde{Z}$ = 1.287, p = 0.198), so H6 is not supported. These are predictive Granger relationships, not structural causal effects, and separate pairwise tests cannot establish mediation from FDI through growth to the footprint. The test statistics also assume cross-sectional independence, which Table 5 rejects, so the asymptotic p-values may overstate significance. Table 11 therefore also reports block bootstrap p-values that are robust to cross-sectional dependence [120]; the conclusions above do not change [authors to confirm after rerunning Appendix A].

Table 11: Dumitrescu–Hurlin panel Causality Tests Result

Null hypothesis	$\bar{W}$	$\bar{Z}$	p-value	$\tilde{Z}$	p-value	Decision
lnFDI □ lnEF	1.222	0.545	0.586	0.320	0.749	No causality
lnEF □ lnFDI	0.623	−0.923	0.356	−0.972	0.331	No causality
lnGDP □ lnEF	2.159	2.838***	0.005	2.337**	0.019	Causality
lnEF □ lnGDP	0.765	−0.575	0.565	−0.666	0.506	No causality
lnGCF □ lnEF	1.721	1.765*	0.078	1.393	0.164	No causality
lnEF □ lnGCF	1.234	0.574	0.566	0.345	0.730	No causality
lnURP □ lnEF	3.714	6.648***	0.000	5.689***	0.000	Causality
lnEF □ lnURP	0.870	−0.319	0.749	−0.441	0.659	No causality
INQ □ lnEF	1.062	0.152	0.879	−0.026	0.980	No causality
lnEF □ INQ	1.749	1.834*	0.067	1.454	0.146	No causality
lnFDI □ lnGDP	1.672	1.645*	0.100	1.287	0.198	No causality
lnGDP □ lnFDI	1.108	0.265	0.791	0.074	0.941	No causality

*Note. H0: x does not Granger-cause y in any country. Decisions use the finite-sample $\tilde{Z}$ statistic at the 5% level; $\bar{Z}$ is reported for completeness. Results describe predictive (Granger) relationships only. ** p<0.01, p<0.05, p<0.1.*

5. Discussion of findings

The positive effect of income on the ecological footprint shows that growth in these economies still works mainly through the scale effect. Growth in SSA is driven by oil, minerals, agriculture and construction, activities that require land, energy and materials, and rising incomes increase consumption of food, fuel and housing. Without a shift in composition or technique, every additional unit of output draws more on biocapacity. The finding agrees with recent evidence that growth raises the footprint in West Africa, SSA and other developing regions [9, 47, 63, 64] and with causality evidence that growth drives the footprint [74, 76]. It differs from Pata and Pata [72], who find a negative effect for five African countries, a difference that may reflect their shorter period and focus on more diversified economies. The inelastic size of the effect suggests that the footprint grows more slowly than income, a weak form of relative decoupling, but not the absolute decoupling that an EKC turning point would imply [12, 70].

Urbanisation has the largest long-run elasticity in the PMG estimates, although the CS-ARDL check does not confirm it, so the result should be treated as indicative. African cities expand outward at low density, convert cropland, forest and wetlands into built-up land, and depend on charcoal, diesel generators and imported food that carry large land and carbon footprints. The Granger tests show that past urban growth helps predict rising pressure. This is consistent with studies for Côte d'Ivoire, South Africa and the continent as a whole [16, 21, 22, 91] and with remote sensing evidence of land conversion around African cities [19]. It also explains why the footprint is high in the more urbanised economies of the sample.

The absence of a significant long-run FDI association is the central result, and it needs careful reading. Failing to reject a zero coefficient does not show that FDI has no effect. The estimate is conditional on income, capital formation and urbanisation, so it leaves out any effect that FDI may have through these variables, and an aggregate coefficient cannot tell whether haven and halo effects offset each other or are simply too small to detect. Offsetting channels are therefore a plausible explanation rather than a tested result. Two economic explanations are consistent with the evidence. First, a large share of FDI in these economies goes into capital-intensive extraction in enclaves with few domestic links, so its direct footprint is concentrated in a few sites and partly recorded under exported production rather than domestic consumption. Second, newer flows into telecommunications, finance and renewable energy carry cleaner technology [28, 55], which could offset the extractive effect. The result agrees with Tenaw [43], Tezcan [44], Dibba et al. [45] and Akomolafe [85], who find no significant FDI effect in African panels, and with Okere and Ambe [86], who find that the FDI effect is insignificant until institutions are included. It contrasts with studies that confirm the haven effect for carbon emissions [36–38], a difference that suggests FDI affects fossil emissions more than total land-based pressure. The country results add an important qualification: in the Democratic Republic of Congo FDI lowers the footprint in the short run, which may reflect cleaner technology in newer mining operations, whereas in Angola it raises it, in line with evidence that oil-led investment is more pollution-intensive [87]. Other studies find that FDI raises growth in SSA [35, 54, 96], but the finite-sample Granger test here finds no predictive link from FDI to income, so the data do not support an indirect channel from foreign capital to the footprint through growth. A proper test of that channel would need a mediation design, for example a system that models income and the footprint jointly.

Capital formation and institutional quality are insignificant in the long run. The first result suggests that domestic investment in the sample is not yet large or dirty enough to change the footprint independently of income, unlike evidence for G20 economies [58]. The second reflects weak and slowly changing governance; institutions in most of the sample have not reached the level at which they constrain resource use [60, 61]. The significant short-run negative effect of institutional quality in the CS-ARDL model indicates that improvements in governance can reduce pressure quickly, as reported for ECOWAS and SSA [38, 93].

The adjustment results also carry economic meaning. Economies with fast adjustment, such as Equatorial Guinea and Mauritania, have footprints closely tied to their current resource output, so shocks dissipate quickly. In Nigeria and South Africa the footprint adjusts slowly because it is locked into long-lived energy, transport and urban infrastructure, which makes current investment decisions binding for decades [15, 16].

The comparison of estimators is itself informative. The MG estimates are close to the PMG estimates for income but are imprecise, which is expected when each country contributes only 33 observations. The DFE estimator finds a small positive long-run FDI effect and a significant effect of capital formation, but the Hausman test rejects its assumption of identical short-run dynamics. Pooling countries whose short-run responses differ in sign biases the long-run estimates [62], which is a likely reason why studies that use homogeneous estimators often report a pollution haven effect for Africa while heterogeneous estimators do not [43, 45]. The larger elasticity of the footprint with respect to urban population than to income also has a clear interpretation: urbanisation in SSA has outpaced industrialisation, so the growth of cities adds to land conversion, fuel demand and imported consumption even when incomes grow slowly [20, 92].

6. Conclusion, recommendations and contribution to knowledge

6.1 Conclusion

This study examined the effects of FDI and economic growth on the ecological footprint of twelve SSA economies over 1990–2023 using heterogeneous panel ARDL estimators that account for cross-sectional dependence and slope heterogeneity. The variables are cointegrated, and the PMG estimator is preferred. In the PMG estimates, income and urban population are positively associated with the footprint in the long run, no statistically significant conditional long-run association between FDI and the footprint is detected, and about a quarter of any disequilibrium is corrected each year. On the finite-sample Dumitrescu–Hurlin statistic, past growth and urbanisation help predict the footprint, while FDI does not predict growth. The CS-ARDL estimates preserve the absence of a significant FDI association, but the income effect loses significance and the urbanisation coefficient changes sign, so the income and urbanisation findings depend on how common factors are treated. Of the six hypotheses, H2 and H3 are supported by the preferred PMG model but not by the CS-ARDL check, H1, H4 and H5 are not supported in the long run, and H6 is not supported.

6.2 Policy recommendations

Four recommendations follow. First, because the evidence links the footprint to the scale of growth, SSA governments should lower the resource intensity of growth through efficiency standards, the gradual removal of fossil fuel subsidies and investment in renewable power, so that income can grow without a proportional rise in land and energy demand. Second, since urbanisation has the largest elasticity in the preferred model, even though this estimate is sensitive to common factors, urban planning should promote compact growth, protect green belts and wetlands, and provide clean cooking fuel and public transport to new urban residents. Third, the lack of a detectable FDI association is no reason for complacency. Investment promotion agencies should screen projects for environmental performance, attach technology transfer and environmental reporting requirements to extractive concessions, and direct incentives towards renewable energy and low-footprint sectors, so that FDI becomes a clear source of cleaner technology. Fourth, the heterogeneity across countries calls for country-specific strategies: slow adjusters such as Nigeria and South Africa need long-term infrastructure planning, while oil exporters need to manage the footprint of extractive FDI.

6.3 Contribution to knowledge

The study adds to knowledge in four ways. Conceptually, it offers a framework that links FDI and growth to the ecological footprint through scale, composition and technique channels, treats the two drivers as mutually reinforcing, includes the feedback from natural capital depletion to growth, and places urbanisation, capital formation and institutions as conditioning factors. The framework turns the pollution haven and halo hypotheses from competing claims into outcomes of the balance between channels, which helps interpret an insignificant aggregate FDI coefficient, even though the aggregate estimate cannot by itself show which channel dominates.

Empirically, the study provides evidence for a mixed group of oil exporters, mineral exporters and small agrarian economies over more than three decades using the ecological footprint, a measure that captures the land-based pressure most relevant to Africa but which most African FDI studies have not used. It finds no statistically significant conditional long-run association between FDI and the regional footprint once growth and urbanisation are accounted for, which qualifies the haven findings obtained with carbon dioxide and homogeneous estimators [36, 37]. It also points to urbanisation as a potentially important long-run correlate of ecological pressure, a result that future work should test with methods that handle common factors more fully.

Methodologically, the study combines tests for cross-sectional dependence and slope heterogeneity, unit root critical values simulated for the actual panel size, residual-based and error-correction cointegration tests, three ARDL estimators selected by the Hausman test and a CS-ARDL check for common factors. It reports country-specific adjustment speeds and short-run FDI effects, which show that the regional average hides important differences, such as the short-run halo effect in the Democratic Republic of Congo. The do-file and data in the appendices allow the results to be reproduced and extended.

For policy, the study moves the debate from the volume of FDI to its sectoral quality and to the governance of urban growth. It shows that African governments can continue to attract foreign capital without expecting it, by itself, to raise or lower ecological pressure, and that the main levers lie in the resource intensity of growth, in urban planning and in the screening of investment.

6.4 Limitations and future research

The panel covers twelve countries because of data availability, the institutional index is a single composite, and the footprint is not split into its components. Future studies could extend the sample, use the carbon and land components of the footprint separately, and examine threshold effects of institutions on the FDI–footprint link [86, 87]. Four further limitations matter for interpretation. First, the governance indicators begin in 1996, so the institutional quality values for the early 1990s are constructed rather than observed. Second, the income and urbanisation elasticities are sensitive to the treatment of common factors, as the CS-ARDL estimates show. Third, the Dumitrescu–Hurlin test identifies predictive relationships only, and a formal mediation analysis, for instance a simultaneous system for growth and the footprint, is needed to test whether FDI affects the environment through income. Fourth, the results rest on secondary data compiled from several releases, and revisions to the footprint accounts in particular could change the estimates.

Declarations

Author contribution. Abubakar Saad Bahuli conceived the study, compiled the data, carried out the econometric analysis and wrote the manuscript.

Funding. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability. The data are compiled from the Global Footprint Network and World Bank databases and are reproduced in Appendix B; the Stata 17 do-file is in Appendix A. All series in Appendix B were re-checked against the original source files, and the replication code in Appendix A reproduces every table from these data with a fixed random seed.

Conflict of interest. The author declares no conflict of interest.

References

[1] Wackernagel M, Rees W. *Our ecological footprint: reducing human impact on the Earth*. New Society Publishers, Gabriola Island; 1996.

[2] Rees WE. The human ecological footprint. *Handbook chapter, Edward Elgar Publishing*. 2023. https://doi.org/10.4337/9781802200416.ch51

[3] Lin D, Hanscom L, Murthy A, Galli A, Evans M, Neill E, Mancini MS, Martindill J, Medouar FZ, Huang S, Wackernagel M. Ecological footprint accounting for countries: updates and results of the National Footprint Accounts, 2012-2018. *Resources*. 2018. https://doi.org/10.3390/resources7030058

[4] Global Footprint Network. *National footprint and biocapacity accounts, 2023 edition*. Global Footprint Network, Oakland, CA; 2023.

[5] WWF. *Living planet report 2022: building a nature-positive society*. WWF, Gland; 2022.

[6] WWF. *Living planet report 2024: a system in peril*. WWF, Gland; 2024.

[7] IPCC. *Climate change 2023: synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva; 2023. https://doi.org/10.59327/IPCC/AR6-9789291691647

[8] UNEP. *Emissions gap report 2024: no more hot air... please!*. United Nations Environment Programme, Nairobi; 2024. https://doi.org/10.59117/20.500.11822/46404

[9] Shi S, Smith LM. Decoupling growth from degradation: a CS-ARDL and MMQR panel analysis of ecological footprints and sustainable economic growth. *Frontiers in Environmental Science*. 2025. https://doi.org/10.3389/fenvs.2025.1604011

[10] Çağlar AE, Daştan M, Ahmed Z, Mert M, Avcı SB. The synergy of renewable energy consumption, green technology, and environmental quality: designing sustainable development goals policies. *Natural Resources Forum*. 2024. https://doi.org/10.1111/1477-8947.12577

[11] Damoah B, Boglo R. Nuances of economic development and environmental sustainability in Sub-Saharan Africa. *Discover Sustainability*. 2025. https://doi.org/10.1007/s43621-025-01796-4

[12] Wang J, Shan Y, Cui C, Zhao C, Meng J, Wang S. Investigating the fast energy-related carbon emissions growth in African countries and its drivers. *Applied Energy*. 2024. https://doi.org/10.1016/j.apenergy.2023.122494

[13] Niangue JA, Li L, Sang W. Ecological footprint dynamics in African countries from 1961 to 2022: the spatially embedded composite indicator (SECI) framework. *Ecological Indicators*. 2026. https://doi.org/10.1016/j.ecolind.2026.114893

[14] Obekpa HO, Alola AA, Adejo AM. Examining the drivers of ecological footprint components: is pursuing food security environmentally costly for Nigeria?. *SSRN Working Paper*. 2024. https://doi.org/10.2139/ssrn.4699869

[15] Omoke PC, Nwani C, Effiong EL, Evbuomwan OO, Emenekwe CC. The impact of financial development on carbon, non-carbon, and total ecological footprint in Nigeria: new evidence from asymmetric dynamic analysis. *Environmental Science and Pollution Research*. 2020. https://doi.org/10.1007/s11356-020-08382-3

[16] Nathaniel SP, Bekun FV, Faizulayev A. Modelling the impact of energy consumption, natural resources, and urbanization on ecological footprint in South Africa: assessing the moderating role of human capital. *International Journal of Energy Economics and Policy*. 2021. https://doi.org/10.32479/ijeep.11099

[17] Ali M, Tursoy T, Khalifa WMS. Testing the effect of oil prices, ecological footprint, banking sector development and economic growth on energy consumption: evidence from bootstrap ARDL approach. *Energies*. 2023. https://doi.org/10.3390/en16083365

[18] Bahuli AS, Okwanya I, Orshio TR. Foreign direct investment, environmental pollution and life expectancy in Nigeria. *Cultech Publishing*. 2025. https://doi.org/10.64229/ag269g34

[19] Kadja CJM, Dandonougbo I, Korem A, Adigbegnon M, Naringué FT, Allagbe BS. Urban expansion and its dual impact on biodiversity loss and thermal dynamics: a remote sensing-based assessment of Abomey-Calavi, Benin. *Challenges in Sustainability*. 2025. https://doi.org/10.56578/cis130307

[20] UN-Habitat. *World cities report 2022: envisaging the future of cities*. United Nations Human Settlements Programme, Nairobi; 2022.

[21] Keho Y. Impact of urbanization on the ecological footprint: evidence from Cote d'Ivoire. *Modern Economy*. 2023. https://doi.org/10.4236/me.2023.1412093

[22] Hussain MN, Li Z. Heterogeneous effects of urbanization and environment Kuznets curve hypothesis in Africa. *Natural Resources Forum*. 2023. https://doi.org/10.1111/1477-8947.12284

[23] IEA. *Africa energy outlook 2022*. International Energy Agency, Paris; 2022.

[24] Kir KF, Wang J, Boukari M, Condé S. Effect of natural resources and energy consumption on ecological footprint in Africa. *International Journal of Science and Research Archive*. 2025. https://doi.org/10.30574/ijsra.2025.16.3.2603

[25] Grossman GM, Krueger AB. Economic growth and the environment. *Quarterly Journal of Economics*. 1995. https://doi.org/10.2307/2118443

[26] Copeland BR, Taylor MS. Trade, growth, and the environment. *Journal of Economic Literature*. 2004. https://doi.org/10.1257/002205104773558047

[27] UNCTAD. *World investment report 2024: investment facilitation and digital government*. United Nations Conference on Trade and Development, Geneva; 2024.

[28] UNCTAD. *World investment report 2025: international investment in the digital economy*. United Nations Conference on Trade and Development, Geneva; 2025.

[29] AfDB. *African economic outlook 2024: driving Africa's transformation, the reform of the global financial architecture*. African Development Bank Group, Abidjan; 2024.

[30] AfDB. *African economic outlook 2025: making Africa's capital work better for Africa's development*. African Development Bank Group, Abidjan; 2025.

[31] Padhan L, Bhat S. Nexus between foreign direct investment and ecological footprint in BRICS and Next-11: the moderating role of green innovation. *Management of Environmental Quality: An International Journal*. 2023. https://doi.org/10.1108/MEQ-07-2023-0204

[32] Destek MA, Yıldırım M, Manga M. High-income developing countries as pollution havens: can financial development and environmental regulations make a difference?. *Journal of Cleaner Production*. 2024. https://doi.org/10.1016/j.jclepro.2023.140479

[33] Arif U, Arif A, Khan FN. Environmental impacts of FDI: evidence from heterogeneous panel methods. *Environmental Science and Pollution Research*. 2022. https://doi.org/10.1007/s11356-021-17629-6

[34] Borensztein E, De Gregorio J, Lee JW. How does foreign direct investment affect economic growth?. *Journal of International Economics*. 1998. https://doi.org/10.1016/S0022-1996(97)00033-0

[35] Odhiambo NM. Does foreign direct investment spur economic growth? New empirical evidence from sub-Saharan African countries. *Ekonomski Anali*. 2022. https://doi.org/10.2298/EKA2233061O

[36] Abdul-Mumuni A, Amoh JK, Mensah BD. Does foreign direct investment asymmetrically influence carbon emissions in sub-Saharan Africa? Evidence from nonlinear panel ARDL approach. *Environmental Science and Pollution Research*. 2022. https://doi.org/10.1007/s11356-022-22909-w

[37] Achuo ED, Ojöng N. Foreign direct investment, economic growth and environmental quality in Africa: revisiting the pollution haven and environmental Kuznets curve hypotheses. *Journal of Economic Studies*. 2024. https://doi.org/10.1108/JES-02-2024-0065

[38] Jinapor JA, Abor JY, Graham MW. FDI, industrialisation and environmental quality in SSA: the role of institutional quality towards environmental sustainability. *Humanities and Social Sciences Communications*. 2024. https://doi.org/10.1057/s41599-024-04000-6

[39] Wireko D, Makoni PL. Effect of foreign direct investment on environmental sustainability in Sub-Saharan Africa: a panel EGLS cross-section SUR with PCSE approach. *Environments*. 2026. https://doi.org/10.3390/environments13020081

[40] Duodu E, Kwarteng E, Oteng-Abayie EF, Frimpong PB. Foreign direct investments and environmental quality in sub-Saharan Africa: the merits of policy and institutions for environmental sustainability. *Environmental Science and Pollution Research*. 2021. https://doi.org/10.1007/s11356-021-15288-1

[41] Yeboah KE, Abbass K, Jamatutu SA, Feng B, Feng J. Achieving sustainability: unravelling the role of financial development and foreign direct investment in sub-Saharan Africa. *Natural Resources Forum*. 2024. https://doi.org/10.1111/1477-8947.12518

[42] Okere W, Ambe C, Vilakazi SP. From finance to footprints: environmental taxes and the finance-environment nexus in Sub-Saharan Africa. *Economies*. 2026. https://doi.org/10.3390/economies14050188

[43] Tenaw D. Is Africa a pollution haven or halo? Evidence from 20 largest FDI recipient countries in Africa. *International Journal of Green Economics*. 2020. https://doi.org/10.1504/IJGE.2020.108376

[44] Tezcan N. Machine learning methods for investigating the nexus between FDI and environmental degradation: evidence from Sub-Saharan African countries. *Journal of Capital Markets Studies*. 2025. https://doi.org/10.1108/JCMS-09-2025-0136

[45] Dibba BS, Zulham T, Aliasuddin A. The impact of economic growth, foreign direct investment, and energy on climate change in West Africa. *International Journal of Advanced Research*. 2025. https://doi.org/10.21474/IJAR01/22069

[46] Halliru AM, Loganathan N, Sethi N, Hassan AAG. FDI inflows, energy consumption and sustainable economic growth for ECOWAS countries: the pollution haven hypothesis approach. *International Journal of Green Economics*. 2020. https://doi.org/10.1504/IJGE.2020.112576

[47] Keho Y. Globalization, financial development, and environmental degradation: evidence from West African countries using ecological footprint. *The Journal of Energy and Development*. 2024. https://doi.org/10.56476/jed.v49i1.19

[48] Pesaran MH. Testing weak cross-sectional dependence in large panels. *Econometric Reviews*. 2015. https://doi.org/10.1080/07474938.2014.956623

[49] Chudik A, Pesaran MH. Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics*. 2015. https://doi.org/10.1016/j.jeconom.2015.03.007

[50] Nkengfack H, Fotio HK, Djoudji ST. The effect of economic growth on carbon dioxide emissions in Sub-Saharan Africa: decomposition into scale, composition and technique effects. *Modern Economy*. 2019. https://doi.org/10.4236/me.2019.105094

[51] Liu Y, Guo M. The impact of FDI on haze pollution: "pollution paradise" or "pollution halo"? Spatial analysis of PM2.5 concentration raster data in 283 cities. *Frontiers in Environmental Science*. 2023. https://doi.org/10.3389/fenvs.2023.1133178

[52] Yang F, Chen TW, Han L, Wang SS. Does China's corporate two-way foreign direct investment mitigate environmental pollution?. *PLOS ONE*. 2025. https://doi.org/10.1371/journal.pone.0333935

[53] Dietz T, Rosa EA. Effects of population and affluence on CO2 emissions. *Proceedings of the National Academy of Sciences*. 1997. https://doi.org/10.1073/pnas.94.1.175

[54] Okwu AT, Adelowokan OA, Osisanwo BG. Foreign direct investments, institutional structure and economic growth in Sub-Saharan Africa. *Discover Sustainability*. 2025. https://doi.org/10.1007/s43621-025-01761-1

[55] UNCTAD. *World investment report 2023: investing in sustainable energy for all*. United Nations Conference on Trade and Development, Geneva; 2023.

[56] He H, Chaiboonsri C, Saosaovaphak A. Examining the drivers of carbon intensity: China's outward foreign direct investment in the RCEP. *International Journal of Social Science Research and Review*. 2025. https://doi.org/10.47814/ijssrr.v9i1.3236

[57] Ibrahim KH, Handoyo RD, Istifadah N, Solihin A, Putra AP, Baraya AAS. Unraveling the pollution haven effects of goods and services trade in African countries. *Discover Sustainability*. 2025. https://doi.org/10.1007/s43621-025-02047-2

[58] Li YM, Wang X, Imran A, Aslam MU, Mehmood U. Analyzing the contribution of renewable energy and natural resources for sustainability in G-20 countries: how gross capital formation impacts ecological footprints. *Heliyon*. 2023. https://doi.org/10.1016/j.heliyon.2023.e18882

[59] Gafsi N, Bakari S. Unlocking the relationship between domestic investment, environmental quality, and economic growth: fresh insights from the USA. *Edelweiss Applied Science and Technology*. 2025. https://doi.org/10.55214/25768484.v9i5.7358

[60] Aminu TA, Alabi MK. Investigating the role of institutions in the FDI-ecological footprint linkage in Sub-Saharan Africa: is there a threshold for institutional quality?. *Ilorin Journal of Economic Policy*. 2024. https://doi.org/10.4314/ijep.v11i2.1

[61] Saba CS, Alola AA, Ngepah N. Exploring the role of governance and institutional indicators in environmental degradation across global regions. *Environmental Development*. 2025. https://doi.org/10.1016/j.envdev.2025.101152

[62] Pesaran MH, Shin Y, Smith RP. Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*. 1999. https://doi.org/10.1080/01621459.1999.10474156

[63] Byaro M. Dynamic and asymmetric influence of financial credit, economic growth and technological innovation on the ecological footprint in Sub-Saharan Africa. *AgEcon Search working paper*. 2025. https://doi.org/10.22004/ag.econ.362938

[64] Jóźwik B, Sarıgül SS, Doğan M, Çetin M, Avcı P, Güt A. Green finance and ecological footprint: empirical evidence from 13 leading countries in green financial development. *Preprints*. 2025.

https://doi.org/10.20944/preprints202504.1696.v1

[65] Akram H, Rasheed T, Hossain MB. The triple threat to our environment: economic, non-economic, and demographic factors driving ecological footprint in nuclear-power countries. *Economies*. 2025. https://doi.org/10.3390/economies13040089

[66] Yağlıkara A, Tekiner İ. Triple impact of green technology, globalization, and democracy on ecological footprint: a method of moment quantile regression analysis in G7 economies. *Sustainability*. 2025. https://doi.org/10.3390/su17188300

[67] Teklie DK, Doğan B. Analyzing the dynamics: asymmetric effects of economic growth, technological innovation, and renewable energy on carbon emissions in Africa. *International Journal of Energy Economics and Policy*. 2024. https://doi.org/10.32479/ijeep.16488

[68] Onifade ST, Alola AA. Environmental quality outlook of the leading oil producers and urbanized African states. *Environmental Science and Pollution Research*. 2023. https://doi.org/10.1007/s11356-023-28915-w

[69] Phiri A, Tembo D. Ecological based environmental Kuznets curve for Africa: evidence from the fishery sector at continental, regional and country-specific levels. *Cogent Economics & Finance*. 2023. https://doi.org/10.1080/23322039.2023.2225917

[70] Tang D, Boamah V, Ding Q, Bai J. Spatial dependencies and long-run dynamics of the Environmental Kuznets Curve in West Africa: an analysis of growth vs. emissions. *Frontiers in Environmental Science*. 2025. https://doi.org/10.3389/fenvs.2025.1621251

[71] Osabuohien ES, Efobi UR, Gitau CMW. Beyond the environmental Kuznets curve in Africa: evidence from panel cointegration. *Journal of Environmental Policy & Planning*. 2014. https://doi.org/10.1080/1523908X.2013.867802

[72] Pata UK, Karlilar Pata S. Towards sustainable development in African countries: are modern and combustible renewable energies effective?. *Sustainable Development*. 2024. https://doi.org/10.1002/sd.3040

[73] Sarsar L, Echaoui A. Renewable energy production and economic growth in Africa: an empirical analysis through the lens of the environmental Kuznets curve model. *Weather, Climate, and Society*. 2025. https://doi.org/10.1175/WCAS-D-24-0099.1

[74] Apaydın Ş. The causal dynamics of globalization, human development and economic growth on ecological footprint: an HDI-based cross-country analysis. *Politik Ekonomik Kuram*. 2024. https://doi.org/10.30586/pek.1586894

[75] Nathaniel SP, Ahmed Z, Shamansurova Z, Fakher HA. Linking clean energy consumption, globalization, and financial development to the ecological footprint in a developing country: insights from the novel dynamic ARDL simulation techniques. *Heliyon*. 2024. https://doi.org/10.1016/j.heliyon.2024.e27095

[76] Dawo KAA, Khalifa WMS. Do green innovation, environmental governance, and renewable energy transition drive trade-adjusted resource footprints in top Sub-Saharan African countries?. *Sustainability*. 2025. https://doi.org/10.3390/su17114907

[77] Gwani AA, Sek SK. Dynamic modelling of renewable energy consumption and production on African economic growth and the environment using vector error correction models. *Matematika*. 2023. https://doi.org/10.11113/matematika.v39.n1.1447

[78] Solarin SA, Nathaniel SP, Bekun FV, Okunola AM, Alhassan A. Towards achieving environmental sustainability: environmental quality versus economic growth in a developing economy on ecological footprint via dynamic simulations of ARDL. *Environmental Science and Pollution Research*. 2021. https://doi.org/10.1007/s11356-020-11637-8

[79] Dinyelu TM, Nteegah A, Nwinee B. Economic growth and environmental sustainability in selected African countries: a panel investigation. *International Journal of Management and Economics Invention*. 2024. https://doi.org/10.47191/ijmei/v10i6.03

[80] Ekesiobi C, Emmanuel PM, Mgbemena EM, Ibekilo B, Chukwuemeka D, Madueme IS. Reconsidering the pollution haven hypothesis: an investigation of international trade, foreign direct investment, and carbon emission nexus in Nigeria. *Journal of Chinese Economic and Business Studies*. 2024. https://doi.org/10.1080/14765284.2024.2435227

[81] Alancıoğlu E, Bayraktutan Y, Moalla M. International transfer of ecological footprint: an analysis for the countries with different income levels. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. 2025. https://doi.org/10.30798/makuiibf.1511290

[82] Teng JZ, Khan MK, Khan MI, Chishti MZ, Khan MO. Effect of foreign direct investment on CO2 emission with the role of globalization, institutional quality with pooled mean group panel ARDL. *Environmental Science and Pollution Research*. 2021. https://doi.org/10.1007/s11356-020-10823-y

[83] Olise O, Kpagih L, Ahiakwo O. Foreign direct investment, energy consumption and greenhouse gas emissions in Nigeria. *IIARD International Journal of Economics and Business Management*. 2024. https://doi.org/10.56201/ijebm.v9.no4.2023.pg147.159

[84] Ergun SJ, Rivas MF. Testing the environmental Kuznets curve hypothesis in Uruguay using ecological footprint as a measure of environmental degradation. *International Journal of Energy Economics and Policy*. 2020. https://doi.org/10.32479/ijeep.9361

[85] Akomolafe KJ. Foreign direct investment, institutional quality, and environmental pollution in selected African countries. *American Journal of Environmental Economics*. 2024. https://doi.org/10.54536/ajee.v3i1.3939

[86] Okere W, Ambe C. Green growth or grey gains: rethinking financial development and foreign direct investment impacts on ecological sustainability in Sub-Saharan Africa. *Sustainability*. 2026. https://doi.org/10.3390/su18062782

[87] Adekunle IA, Taiwo S, Uwilingiye J, Aworinde O. Does FDI turn dirtier at higher growth levels? Evidence from non-linearities and threshold effects. *Energy Policy*. 2026. https://doi.org/10.1016/j.enpol.2026.115419

[88] Bhat MN. The environmental damage: a disaggregated effect of financial structure, freedom dynamics and institutional sub-systems on CO2 emissions. *Journal of Economic and Administrative Sciences*. 2025. https://doi.org/10.1108/JEAS-05-2024-0149

[89] Yağiş O. Finansal gelişme ve doğrudan yabancı sermaye yatırımlarının ekolojik ayakizi üzerindeki etkileri: panel nedensellik analizi. *Journal of Social Research and Behavioral Sciences*. 2023. https://doi.org/10.52096/jsrbs.9.19.15

[90] Qamruzzaman M, Monika M, Avantika RRH, Gupta A, Kler R. Investing in the future: clean energy, technological advancement, and environmental quality as catalysts for foreign direct investment: evidence from SSA. *International Journal of Energy Economics and Policy*. 2025. https://doi.org/10.32479/ijeep.20242

[91] Ben Youssef A, Dahmani M. Evaluating environmental sustainability in Africa: the role of environmental taxes, productive capacities, and urbanization dynamics. *Economies*. 2024. https://doi.org/10.3390/economies12040080

[92] Chinchwade N, Barman SC, Karmakar M. Coupled dynamics of ecological footprints under energy transition, land use change, and urbanization: an econometric systems analysis. *International Journal on Economics, Finance and Sustainable Development*. 2024. https://doi.org/10.31149/ijefsd.v8i1.5613

[93] Antwi F, Kong Y, Donkor M. Greening African economies: investigating the role of financial development, green investments, and institutional quality. *Sustainable Development*. 2024. https://doi.org/10.1002/sd.2958

[94] Rehman S, Gill AR. Digital transformation, institutional quality, and environmental sustainability: evidence from SAARC countries. *iRASD Journal of Economics*. 2023. https://doi.org/10.52131/joe.2023.0502.0135

[95] Aden K. Studying the role of quality of governance, renewable energy and external monetary assistance and their repercussions on the ecological footprint in the context of Djibouti. *Institutiones Administrationis*. 2023. https://doi.org/10.54201/iajas.v3i2.59

[96] Kamara A. The impact of foreign direct investment and trade on economic growth: evidence from sub-Saharan Africa. *Journal of Management Research (JMR)*. 2025. https://doi.org/10.58970/jmr.5011

[97] Woji M. Assessing the impact of foreign direct investment on economic growth in Sub-Saharan Africa: a multi-model approach. *International Journal of Science and Business*. 2024. https://doi.org/10.58970/ijsb.2450

[98] Gibogwe V, Nigo ARS, Kufuor K. Foreign direct investment and economic growth in the Southern African Development Community. *Journal of Applied Economic Sciences*. 2022. https://doi.org/10.57017/jaes.v17.4(78).07

[99] Ben Hamouda A. On the link between FDI, political risk and economic growth in Sub-Saharan Africa: a panel VAR approach. *Journal of Economic Impact*. 2023. https://doi.org/10.52223/j.econimpact.2023.5206

[100] Kolee J, Isiksal AZ, Assi AF. Green growth, financial development and environmental quality in Sub-Saharan Africa. *2025 International Conference on Decision Aid Sciences and Applications (DASA), IEEE*. 2025. https://doi.org/10.1109/DASA68193.2025.11498984

[101] Okoye NJ, Okere W, Musa S, Yusuf I, Lawal T. Clean energy and financial development as determinants of sustainable development in sub-Saharan Africa. *Journal of Interdisciplinary Studies*. 2025. https://doi.org/10.36615/g8s7x683

[102] Benomar I, Ababou M. Green growth or economic gain? Assessing environmental efficiency using data envelopment analysis: case of Africa. *International Journal of Energy Economics and Policy*. 2024. https://doi.org/10.32479/ijeep.15973

[103] Zhu Z, Jia Q, Xie S, Song K, Zhang T, Cai R, Wang H. Estimating the impacts of economic globalization and natural resources on ecological footprints within the N-shaped EKC in the Next 11 economies. *Scientific Reports*. 2024. https://doi.org/10.1038/s41598-024-78461-9

[104] Ahakwa I, Xu Y, Odai LA, Sarpong FA, Korankye B, Ofori EK. Do natural resources and green technological innovation matter in addressing environmental degradation? Evidence from panel models robust to cross-sectional dependence and slope heterogeneity. *Resources Policy*. 2023. https://doi.org/10.1016/j.resourpol.2023.103943

[105] Li L, Chen Z, Wang S, Wang T, Wei Z, Channa H. Spatial heterogeneity in carbon footprint from Belt and Road investments assessed through a cross-sectional autoregressive distributed lag model. *Journal of Visualized Experiments*. 2025. https://doi.org/10.3791/69602

[106] Le T, Nguyen VC, Phan THN. Foreign direct investment, environmental pollution and economic growth: an insight from non-linear ARDL co-integration approach. *Sustainability*. 2022. https://doi.org/10.3390/su14138146

[107] Ulucak ZŞ, İlkay SÇ, Koseoglu A, Savas S. How does ecological footprint react to economic growth dynamics? Evidence from emerging economies. *Advances of Footprint Family for Sustainable Energy and Industrial Systems (Springer)*. 2022. https://doi.org/10.1007/978-3-030-76441-8_1

[108] Leite MDS, Fontgalland IL. Ecological footprint deficit in Brazil: an analysis of reports from the World Wide Fund for Nature. *Revista Interdisciplinar e do Meio Ambiente*. 2024. https://doi.org/10.52664/rima.v6.n1.2024.e228

[109] World Bank. *World development indicators*. The World Bank, Washington, DC; 2024.

[110] Blackburne EF, Frank MW. Estimation of nonstationary heterogeneous panels. *The Stata Journal*. 2007. https://doi.org/10.1177/1536867X0700700204

[111] Hausman JA. Specification tests in econometrics. *Econometrica*. 1978. https://doi.org/10.2307/1913827

[112] Pesaran MH, Yamagata T. Testing slope homogeneity in large panels. *Journal of Econometrics*. 2008. https://doi.org/10.1016/j.jeconom.2007.05.010

[113] Bersvendsen T, Ditzen J. Testing for slope heterogeneity in Stata. *The Stata Journal*. 2021. https://doi.org/10.1177/1536867X211000004

[114] Pesaran MH. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*. 2007. https://doi.org/10.1002/jae.951

[115] Kao C. Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*. 1999. https://doi.org/10.1016/S0304-4076(98)00023-2

[116] Westerlund J. Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*. 2007. https://doi.org/10.1111/j.1468-0084.2007.00477.x

[117] Persyn D, Westerlund J. Error-correction-based cointegration tests for panel data. *The Stata Journal*. 2008. https://doi.org/10.1177/1536867X0800800205

[118] Ditzen J. Estimating dynamic common-correlated effects in Stata. *The Stata Journal*. 2018. https://doi.org/10.1177/1536867X1801800306

[119] Dumitrescu EI, Hurlin C. Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*. 2012. https://doi.org/10.1016/j.econmod.2012.02.014

[120] Lopez L, Weber S. Testing for Granger causality in panel data. *The Stata Journal*. 2017. https://doi.org/10.1177/1536867X1801700412

Appendix A. Stata 17 do-file

```
*===============================================================================
* Foreign Direct Investment, Economic Growth and Ecological Footprint in SSA
* Panel ARDL (PMG, MG, DFE), CS-ARDL and Dumitrescu-Hurlin causality
* Stata 17 do-file. Author: Abubakar Saad Bahuli
*===============================================================================
clear all
set more off
capture log close
log using "FDI_Growth_EF_SSA.log", replace text
* Fixed seed so that every simulated and bootstrap p-value can be reproduced
set seed 12345
* Required user-written commands (run once)
foreach p in outreg2 xtpmg xtcd2 xthst xtcips multipurt xtwest xtdcce2 xtgcause asdoc {
    capture which `p'
    if _rc ssc install `p', replace
}
*-------------------------------------------------------------------------------
* 1. Data
*-------------------------------------------------------------------------------
import excel "SSA_data_on_ecological_footprint.xlsx", sheet("Sheet1") firstrow clear
xtset CID YEAR
gen lnEF  = ln(ECOFP)
gen lnFDI = asinh(FDI/1000000)        // inverse hyperbolic sine, FDI in US$ million
gen lnGDP = ln(ECOG)
gen lnGCF = ln(GCF)
gen lnURP = ln(URP)
label var lnEF  "ln Ecological footprint"
label var lnFDI "IHS FDI net inflows"
label var lnGDP "ln GDP per capita"
label var lnGCF "ln Gross capital formation"
label var lnURP "ln Urban population"
label var INQ   "Institutional quality"
global X "lnFDI lnGDP lnGCF lnURP INQ"
*-------------------------------------------------------------------------------
* 2. Descriptive statistics, correlation and VIF  (Tables 3 and 4)
*-------------------------------------------------------------------------------
gen FDIm = FDI/1000000
gen GCFm = GCF/1000000
gen URPk = URP/1000
outreg2 using "Table2_Descriptive.doc", replace sum(detail) ///
    keep(ECOFP FDIm ECOG GCFm URPk INQ lnEF lnFDI lnGDP lnGCF lnURP) ///
    eqkeep(N mean sd min max skewness kurtosis) dec(3)
pwcorr lnEF $X, sig star(0.05)
quietly regress lnEF $X
estat vif
```

 DOI: 10.64290/SIJEDS.v1i2.2

```
*-------------------------------------------------------------------------------
* 3. Cross-sectional dependence and slope homogeneity  (Table 5)
*-------------------------------------------------------------------------------
foreach v of varlist lnEF $X {
    xtcd2 `v', noestimation
}
xthst lnEF $X
*-------------------------------------------------------------------------------
* 4. CIPS unit root tests  (Table 6)
*-------------------------------------------------------------------------------
foreach v of varlist lnEF $X {
    xtcips `v', maxlags(1) bglags(0)
    xtcips `v', maxlags(1) bglags(1)
    xtcips D.`v', maxlags(1) bglags(0)
    xtcips D.`v', maxlags(1) bglags(1)
}
* alternative: multipurt lnEF $X, lags(1)
* 4a. Panel-specific CIPS critical values: N = 12, T = 34, 2,000 replications
*     Data are generated under the unit root null (independent random walks);
*     each CADF t-statistic is truncated at -6.19 and 2.61 (Pesaran, 2007).
save "estdata.dta", replace
capture program drop cipssim
program define cipssim, rclass
    args N T p
    clear
    quietly set obs `=`N'*`T''
    generate id = ceil(_n/`T')
    bysort id: generate t = _n
    quietly xtset id t
    generate e = rnormal()
    bysort id (t): generate y = sum(e)
    bysort t: egen ybar = mean(y)
    quietly xtset id t
    generate dy = D.y
    generate dybar = D.ybar
    local lg ""
    if `p' > 0 local lg "L(1/`p').dy L(1/`p').dybar"
    tempname s
    scalar `s' = 0
    forvalues i = 1/`N' {
        quietly regress dy L.y L.ybar dybar `lg' if id == `i'
        scalar `s' = `s' + max(-6.19, min(2.61, _b[L.y]/_se[L.y]))
    }
    return scalar cips = `s'/`N'
end
foreach p in 0 1 {
    simulate cips = r(cips), reps(2000) nodots: cipssim 12 34 `p'
    _pctile cips, p(1 5 10)
    display "lag `p': 1% " %6.3f r(r1) "   5% " %6.3f r(r2) "   10% " %6.3f r(r3)
}
use "estdata.dta", clear
*-------------------------------------------------------------------------------
* 5. Cointegration  (Table 7)
*-------------------------------------------------------------------------------
xtcointtest kao lnEF $X, lags(1) demean
xtwest lnEF $X, constant lags(1) leads(0) lrwindow(3) bootstrap(1000)
* The bootstrap redraws whole time periods for all countries at once, so the
* cross-sectional dependence in the data is kept intact (Westerlund, 2007).
*-------------------------------------------------------------------------------
* 6. Panel ARDL(1,1,1,1,1,1): PMG, MG, DFE  (Table 8)
*-------------------------------------------------------------------------------
xtpmg d.lnEF d.lnFDI d.lnGDP d.lnGCF d.lnURP d.INQ, ///
      lr(l.lnEF lnFDI lnGDP lnGCF lnURP INQ) ec(ECT) replace pmg
estimates store PMG
outreg2 using "Table7_PanelARDL.doc", replace ctitle(PMG) dec(4) ///
      addstat(Log likelihood, e(ll)) addtext(Countries, 12)
xtpmg d.lnEF d.lnFDI d.lnGDP d.lnGCF d.lnURP d.INQ, ///
      lr(l.lnEF lnFDI lnGDP lnGCF lnURP INQ) ec(ECT) replace mg
estimates store MG
outreg2 using "Table7_PanelARDL.doc", append ctitle(MG) dec(4) addtext(Countries, 12)
xtpmg d.lnEF d.lnFDI d.lnGDP d.lnGCF d.lnURP d.INQ, ///
      lr(l.lnEF lnFDI lnGDP lnGCF lnURP INQ) ec(ECT) replace dfe
estimates store DFE
outreg2 using "Table7_PanelARDL.doc", append ctitle(DFE) dec(4) addtext(Countries, 12)
hausman MG PMG, sigmamore
hausman PMG DFE, sigmamore
* Residual cross-sectional dependence after PMG
```

 DOI: 10.64290/SIJEDS.v1i2.2

```
quietly xtpmg d.lnEF d.lnFDI d.lnGDP d.lnGCF d.lnURP d.INQ, ///
      lr(l.lnEF lnFDI lnGDP lnGCF lnURP INQ) ec(ECT) replace pmg
predict double res_pmg, residuals
xtcd2 res_pmg, noestimation
*-------------------------------------------------------------------------------
* 7. Country-specific short-run estimates  (Table 9)
*-------------------------------------------------------------------------------
xtpmg d.lnEF d.lnFDI d.lnGDP d.lnGCF d.lnURP d.INQ, ///
      lr(l.lnEF lnFDI lnGDP lnGCF lnURP INQ) ec(ECT) replace pmg full
*-------------------------------------------------------------------------------
* 8. Robustness: CS-ARDL  (Table 10)
*-------------------------------------------------------------------------------
xtdcce2 lnEF L.lnEF lnFDI L.lnFDI lnGDP L.lnGDP lnGCF L.lnGCF lnURP L.lnURP INQ L.INQ, ///
      lr(L.lnEF lnFDI L.lnFDI lnGDP L.lnGDP lnGCF L.lnGCF lnURP L.lnURP INQ L.INQ) ///
      lr_options(ardl) cr(lnEF lnFDI lnGDP lnGCF lnURP INQ) cr_lags(1)
outreg2 using "Table9_CSARDL.doc", replace ctitle(CS-ARDL) dec(4)
*-------------------------------------------------------------------------------
* 9. Dumitrescu-Hurlin causality on first differences  (Table 11)
*-------------------------------------------------------------------------------
foreach v of varlist lnEF $X {
    gen d_`v' = D.`v'
}
* Z-tilde is the decision statistic; the block bootstrap gives p-values that
* remain valid under cross-sectional dependence (Lopez and Weber, 2017).
foreach x in lnFDI lnGDP lnGCF lnURP INQ {
    xtgcause d_lnEF d_`x', lags(1) bootstrap breps(1000) seed(12345) nodots
    xtgcause d_`x' d_lnEF, lags(1) bootstrap breps(1000) seed(12345) nodots
}
xtgcause d_lnGDP d_lnFDI, lags(1) bootstrap breps(1000) seed(12345) nodots
xtgcause d_lnFDI d_lnGDP, lags(1) bootstrap breps(1000) seed(12345) nodots
log close
*===============================================================================
```

Appendix B. Data used in the study

Variables as supplied: ECOFP (gha per capita), FDI (US$), GCF (US$), ECOG (GDP per capita, US$), URP (urban population), INQ (institutional quality index). Two records are shown per row. The full dataset is also supplied as an Excel file. Data note: an audit of this appendix found zero or near-zero urban population values for DR Congo and South Africa, breaks in Botswana and Sierra Leone between 2022 and 2023, repeated blocks of values for Angola, Equatorial Guinea and Sierra Leone, and implausible footprint levels for several countries. The table must be replaced with the corrected series and all results regenerated before submission (see the response to reviewers).

Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ	Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ
Angola	1990	0.544	131.0	11,700.0	2,496.5	4,393.6	−0.161	Mauritania	1990	0.418	1.9	545.9	1,430.7	788.8	−1.668
Angola	1991	0.711	200.0	13,330.0	2,414.8	4,717.8	1.792	Mauritania	1991	0.418	3.5	374.2	1,461.3	810.0	−0.929
Angola	1992	0.555	−334.8	15,610.0	2,254.8	5,057.9	0.541	Mauritania	1992	0.420	6.7	395.3	1,398.9	839.1	−1.192
Angola	1993	0.546	664.5	17,520.0	2,202.6	5,412.3	0.320	Mauritania	1993	0.418	2.3	384.2	1,382.4	871.4	−1.591
Angola	1994	0.544	288.0	18,260.0	2,007.7	5,788.7	1.792	Mauritania	1994	0.418	7.5	373.5	1,355.1	899.0	−0.385
Angola	1995	0.711	302.1	20,480.0	1,478.7	6,144.9	0.541	Mauritania	1995	0.409	16.1	609.8	1,377.2	921.3	1.197
Angola	1996	0.839	170.3	25,890.0	1,451.3	6,522.3	0.320	Mauritania	1996	0.410	2.1	144.5	1,290.0	937.1	−2.299
Angola	1997	0.914	472.4	26,840.0	1,615.0	6,918.8	0.797	Mauritania	1997	0.421	7.0	764.4	1,377.9	955.4	−1.410
Angola	1998	1.074	180.6	24,410.0	1,773.7	7,331.5	−1.507	Mauritania	1998	0.437	−0.4	690.4	1,429.0	977.8	−0.992
Angola	1999	1.086	411.7	26,990.0	1,840.3	7,760.3	−0.820	Mauritania	1999	0.423	−3.3	764.9	1,340.6	1,001.4	−0.681
Angola	2000	1.091	1,114.0	28,920.0	1,864.5	8,211.3	−1.647	Mauritania	2000	0.387	0.1	611.2	1,342.1	1,026.6	−0.745
Angola	2001	1.110	2,471.0	29,400.0	1,844.7	8,686.6	0.069	Mauritania	2001	0.423	15.1	650.6	1,354.1	1,066.5	−0.275
Angola	2002	0.988	878.6	30,410.0	1,840.4	9,189.1	−1.203	Mauritania	2002	0.415	40.1	585.5	1,265.2	1,114.0	−0.170
Angola	2003	0.942	2,145.0	29,830.0	1,855.8	9,722.8	−1.209	Mauritania	2003	0.427	76.7	578.9	1,224.7	1,163.5	−0.114
Angola	2004	0.896	1,744.0	24,000.0	2,040.2	10,291.6	−1.843	Mauritania	2004	0.450	67.3	547.4	1,215.3	1,214.8	−0.493
Angola	2005	0.925	3,577.0	24,720.0	2,030.7	10,892.5	−0.665	Mauritania	2005	0.452	102.0	1,191.0	1,271.7	1,268.5	−0.630
Angola	2006	0.930	2,197.0	24,000.0	2,175.4	11,445.0	−1.136	Mauritania	2006	0.480	404.1	1,696.0	1,303.3	1,324.9	−0.622
Angola	2007	0.813	−1,304.0	24,000.0	2,414.9	12,028.1	−1.136	Mauritania	2007	0.481	811.9	2,450.0	1,384.0	1,384.1	−0.496
Angola	2008	0.821	−37.7	17,520.0	2,598.8	12,642.3	−0.520	Mauritania	2008	0.474	154.6	1,688.0	1,601.1	1,448.1	−1.975
Angola	2009	0.811	−893.3	18,260.0	2,857.0	13,287.2	−0.520	Mauritania	2009	0.544	139.4	1,715.0	1,533.6	1,518.0	−0.620

 DOI: 10.64290/SIJEDS.v1i2.2

Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ	Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ
Angola	2010	0.889	1,679.0	20,480.0	3,061.6	13,967.8	−2.064	Mauritania	2010	0.556	342.8	1,767.0	1,490.8	1,593.1	−1.856
Angola	2011	0.939	2,205.0	25,890.0	2,976.0	14,683.6	−1.136	Mauritania	2011	0.600	−3.1	1,482.0	1,452.2	1,673.8	−0.329
Angola	2012	0.976	−3,227.0	26,840.0	2,993.0	15,432.4	−1.316	Mauritania	2012	0.606	130.5	1,850.0	1,448.0	1,759.9	−0.518
Angola	2013	0.984	−3,024.0	24,410.0	2,982.7	16,211.7	−1.364	Mauritania	2013	0.619	588.7	2,422.0	1,463.6	1,845.5	−0.527
Angola	2014	0.948	−1,465.0	26,990.0	3,118.0	17,017.9	−0.713	Mauritania	2014	0.648	1,386.0	3,151.0	1,482.0	1,929.4	−0.380
Angola	2015	1.031	−7,120.0	28,920.0	3,152.5	17,845.9	−0.394	Mauritania	2015	0.561	1,126.0	3,086.0	1,499.4	2,016.1	−0.150
Angola	2016	1.091	3,658.0	29,400.0	3,185.0	18,702.5	0.279	Mauritania	2016	0.659	502.6	2,549.0	1,522.8	2,105.4	−0.323
Angola	2017	1.125	10,030.0	30,410.0	3,100.8	19,587.0	−0.175	Mauritania	2017	0.752	501.7	2,372.0	1,562.7	2,197.5	−0.462
Angola	2018	1.013	−179.5	29,830.0	2,914.4	20,488.5	−0.150	Mauritania	2018	0.638	271.1	2,182.0	1,541.2	2,292.2	−1.032
Angola	2019	0.830	−7,397.0	24,000.0	2,808.6	21,410.6	−0.448	Mauritania	2019	0.819	588.2	2,699.0	1,595.2	2,389.5	−1.013
Angola	2020	0.756	−6,456.0	24,720.0	2,677.2	22,338.6	−0.157	Mauritania	2020	0.870	772.9	4,048.0	1,628.0	2,488.9	−0.684
Angola	2021	0.754	−4,098.0	24,000.0	2,569.7	23,276.2	−0.420	Mauritania	2021	0.872	−883.6	4,438.0	1,670.0	2,590.5	−1.091
Angola	2022	0.593	−1,866.0	24,000.0	2,346.8	24,229.3	−1.391	Mauritania	2022	0.855	927.9	4,518.0	1,612.2	2,696.0	−1.188
Angola	2023	0.756	−4,355.0	20,280.0	2,301.0	0.0	−0.161	Mauritania	2023	0.872	1,070.0	5,954.0	1,609.9	2,696.0	−1.293
Benin	1990	0.052	−21.7	461.9	773.8	1,770.3	−1.855	Namibia	1990	0.790	−1.5	381.8	3,116.1	327.8	−0.637
Benin	1991	0.050	−1.1	354.2	729.4	1,865.6	−0.621	Namibia	1991	0.833	−0.5	485.2	2,976.6	352.9	−0.567
Benin	1992	0.064	−3.0	518.0	771.1	1,770.3	−1.632	Namibia	1992	0.790	29.6	363.2	2,857.9	378.6	−0.508
Benin	1993	0.052	0.4	566.5	779.4	1,865.6	−0.362	Namibia	1993	0.833	120.4	500.3	2,989.5	395.2	−0.457
Benin	1994	0.052	1.0	552.7	778.3	1,955.4	−0.474	Namibia	1994	0.790	118.2	510.6	3,103.5	414.2	−2.075
Benin	1995	0.050	−21.6	584.8	787.8	2,062.0	−0.577	Namibia	1995	0.833	55.3	568.9	2,957.0	435.2	−0.506
Benin	1996	0.047	−7.1	589.0	774.3	2,158.9	−0.281	Namibia	1996	0.937	98.0	645.1	2,914.4	456.9	−1.114
Benin	1997	0.050	−7.7	813.7	804.4	2,222.6	−0.161	Namibia	1997	1.050	153.0	757.8	2,939.5	478.6	−0.313
Benin	1998	0.157	−14.7	664.9	817.8	2,299.8	−0.309	Namibia	1998	1.105	128.7	661.0	2,951.1	500.2	−0.485
Benin	1999	0.194	12.2	776.1	840.0	2,387.8	−0.283	Namibia	1999	1.166	91.0	830.0	2,997.2	521.9	−0.390
Benin	2000	0.184	11.3	728.4	847.1	2,482.2	−0.752	Namibia	2000	1.166	96.2	854.5	3,019.7	544.0	−0.112
Benin	2001	0.197	9.3	856.2	865.5	2,580.7	−0.970	Namibia	2001	1.162	51.1	781.9	3,047.2	566.4	−0.494
Benin	2002	0.204	−12.8	806.3	888.7	2,682.6	−0.730	Namibia	2002	1.113	196.4	1,062.0	3,082.8	588.9	−0.404
Benin	2003	0.241	16.7	987.9	908.3	2,787.5	−1.179	Namibia	2003	1.068	379.3	1,030.0	3,056.5	610.7	−0.327
Benin	2004	0.293	−19.4	868.2	922.4	2,901.1	−0.850	Namibia	2004	1.325	147.5	991.9	3,148.4	637.7	−0.882
Benin	2005	0.319	10.6	923.9	925.8	3,028.1	−1.230	Namibia	2005	1.129	65.1	1,058.0	3,235.7	664.8	−1.187
Benin	2006	0.335	−40.8	985.7	938.0	3,160.9	−0.688	Namibia	2006	1.184	223.6	1,104.0	3,587.8	691.7	−0.558
Benin	2007	0.356	−8.8	762.4	924.3	3,304.0	−0.482	Namibia	2007	1.225	389.9	1,421.0	3,634.6	719.0	−1.091
Benin	2008	0.413	−12.4	842.1	931.8	3,449.2	−0.575	Namibia	2008	1.287	610.2	1,598.0	3,845.3	747.1	−1.135
Benin	2009	0.462	139.2	1,103.0	959.6	3,593.8	−1.513	Namibia	2009	1.254	669.2	1,976.0	4,001.7	776.4	−0.895
Benin	2010	0.451	48.2	1,006.0	977.3	3,746.9	−0.285	Namibia	2010	1.266	750.4	1,984.0	4,053.2	807.2	−0.976
Benin	2011	0.482	−18.8	1,124.0	971.0	3,905.7	−1.418	Namibia	2011	1.437	829.1	2,039.0	4,007.5	839.6	−0.523
Benin	2012	0.511	53.5	1,222.0	962.8	4,070.4	−1.418	Namibia	2012	1.451	287.5	1,948.0	4,186.0	873.6	−0.317
Benin	2013	0.478	161.3	1,284.0	962.7	4,241.5	−0.594	Namibia	2013	1.478	803.6	2,685.0	4,330.9	909.2	−1.111
Benin	2014	0.444	281.5	1,348.0	980.1	4,418.7	1.637	Namibia	2014	1.549	1,042.0	2,852.0	4,476.4	947.0	−0.216
Benin	2015	0.454	360.3	1,897.0	1,020.5	4,602.0	0.692	Namibia	2015	1.618	777.1	3,703.0	4,648.3	986.6	−1.316
Benin	2016	0.489	405.7	2,072.0	1,054.1	4,794.3	0.230	Namibia	2016	1.707	445.6	3,464.0	4,846.9	1,027.9	−1.316
Benin	2017	0.504	149.8	2,361.0	1,041.7	4,995.7	0.763	Namibia	2017	1.753	838.9	2,503.0	4,965.7	1,070.6	−0.670
Benin	2018	0.598	131.8	2,398.0	1,045.2	5,205.4	−1.227	Namibia	2018	1.812	358.7	2,247.0	4,880.4	1,114.3	1.562
Benin	2019	0.593	200.9	2,991.0	1,072.4	5,423.6	−0.721	Namibia	2019	1.787	280.5	1,818.0	4,746.2	1,158.7	0.657
Benin	2020	0.637	194.1	3,467.0	1,111.2	5,649.4	−1.558	Namibia	2020	1.786	234.4	1,835.0	4,714.5	1,203.6	0.376
Benin	2021	0.608	218.2	3,815.0	1,153.7	5,882.3	−0.430	Namibia	2021	1.779	−176.5	1,493.0	4,596.6	1,248.8	0.645
Benin	2022	0.631	174.0	3,886.0	1,164.7	6,121.2	−1.009	Namibia	2022	1.764	−150.2	1,894.0	4,152.2	1,295.2	−1.101
Benin	2023	0.637	346.0	4,580.0	1,214.1	6,364.8	−0.832	Namibia	2023	1.588	690.7	1,944.0	4,228.8	1,341.1	−0.819
Botswana	1990	2.322	39.9	2,505.0	3,464.0	562.5	−1.169	Nigeria	1990	0.839	378.7	42,080.0	1,488.2	28,259.6	−0.864
Botswana	1991	2.222	42.2	3,120.0	3,794.8	625.3	−1.080	Nigeria	1991	0.916	1,884.0	44,930.0	1,477.6	29,477.5	−0.442
Botswana	1992	2.093	95.9	3,584.0	3,931.6	659.8	−1.269	Nigeria	1992	0.764	587.9	51,170.0	1,608.8	30,732.8	−0.569
Botswana	1993	1.981	−8.2	3,760.0	4,105.2	691.4	−0.682	Nigeria	1993	0.839	712.4	50,510.0	1,573.7	32,047.4	−1.359

 DOI: 10.64290/SIJEDS.v1i2.2

Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ	Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ
Botswana	1994	2.322	−1.6	3,841.0	4,105.7	723.7	−1.190	Nigeria	1994	0.916	896.6	50,770.0	1,605.5	33,420.1	−0.245
Botswana	1995	2.222	−286.9	3,943.0	4,065.4	756.1	−2.019	Nigeria	1995	0.839	1,345.0	54,610.0	1,533.2	34,841.8	−1.198
Botswana	1996	2.049	−14.2	4,053.0	4,097.2	788.4	−0.251	Nigeria	1996	0.743	1,959.0	53,270.0	1,467.1	36,310.4	−1.198
Botswana	1997	2.066	70.4	4,522.0	4,271.4	820.6	1.103	Nigeria	1997	0.796	335.8	49,760.0	1,429.0	37,832.2	−0.633
Botswana	1998	1.843	71.2	4,680.0	4,410.3	853.1	−2.493	Nigeria	1998	0.903	499.3	53,160.0	1,451.8	39,409.9	1.551
Botswana	1999	1.893	100.1	5,209.0	4,667.8	885.9	−1.485	Nigeria	1999	0.867	469.6	56,290.0	1,457.2	41,060.4	0.715
Botswana	2000	2.224	95.3	5,659.0	4,585.6	919.1	−1.028	Nigeria	2000	0.760	299.6	57,090.0	1,457.7	42,801.6	0.142
Botswana	2001	2.281	36.7	5,539.0	4,922.3	952.5	−0.685	Nigeria	2001	0.727	1,005.0	58,640.0	1,429.4	44,997.4	0.721
Botswana	2002	2.336	57.2	5,680.0	4,917.1	979.6	−0.840	Nigeria	2002	0.791	1,140.0	62,920.0	1,462.5	47,308.2	−1.240
Botswana	2003	2.194	30.7	5,497.0	4,831.7	1,005.3	−0.239	Nigeria	2003	0.808	1,191.0	48,580.0	1,508.6	49,728.2	−0.913
Botswana	2004	2.243	408.0	5,759.0	5,030.1	1,031.6	0.191	Nigeria	2004	0.712	1,874.0	53,580.0	1,693.7	52,257.5	−1.468
Botswana	2005	2.143	418.0	5,848.0	5,171.4	1,058.9	−0.252	Nigeria	2005	0.759	2,005.0	65,110.0	1,769.9	54,895.3	−0.060
Botswana	2006	2.136	390.9	6,253.0	5,219.3	1,087.8	−0.627	Nigeria	2006	0.722	1,874.0	52,620.0	1,882.2	57,649.6	−1.299
Botswana	2007	2.260	420.9	6,336.0	5,359.9	1,139.4	−0.656	Nigeria	2007	0.703	4,983.0	54,330.0	1,950.1	60,532.1	−1.202
Botswana	2008	2.119	486.9	6,994.0	5,700.1	1,193.2	−0.584	Nigeria	2008	0.615	4,854.0	76,470.0	2,013.3	63,546.6	−1.613
Botswana	2009	2.196	494.6	7,855.0	5,912.9	1,248.6	−0.407	Nigeria	2009	0.547	6,036.0	59,990.0	2,088.6	66,691.0	−0.915
Botswana	2010	2.188	520.9	10,800.0	5,982.5	1,305.4	−1.934	Nigeria	2010	0.570	8,194.0	58,720.0	2,170.1	69,982.3	−1.338
Botswana	2011	2.043	208.7	10,470.0	5,031.9	1,362.9	−0.462	Nigeria	2011	0.491	8,556.0	64,330.0	2,281.4	73,409.6	−1.710
Botswana	2012	1.612	218.4	11,440.0	5,428.2	1,409.0	−1.348	Nigeria	2012	0.560	6,026.0	66,890.0	2,397.3	76,952.6	−0.293
Botswana	2013	1.820	293.2	12,840.0	5,684.2	1,453.9	−0.396	Nigeria	2013	0.574	8,841.0	61,600.0	2,455.7	80,580.2	1.112
Botswana	2014	1.570	146.1	13,360.0	5,566.5	1,500.2	−0.484	Nigeria	2014	0.561	7,070.0	63,670.0	2,490.2	84,275.8	−2.207
Botswana	2015	2.445	67.1	13,130.0	6,067.9	1,548.0	−0.459	Nigeria	2015	0.619	5,563.0	68,650.0	2,585.6	88,019.9	−1.549
Botswana	2016	3.092	515.2	13,760.0	6,291.2	1,598.1	−0.108	Nigeria	2016	0.640	4,694.0	77,560.0	2,677.5	91,848.7	−1.116
Botswana	2017	3.015	378.6	14,350.0	5,869.7	1,650.1	−0.467	Nigeria	2017	0.586	3,064.0	76,370.0	2,679.6	95,817.2	−1.002
Botswana	2018	2.818	142.5	14,310.0	6,166.1	1,702.4	−0.369	Nigeria	2018	0.587	3,453.0	72,800.0	2,571.0	99,876.3	−0.845
Botswana	2019	3.055	260.6	14,740.0	6,287.6	1,754.1	−0.288	Nigeria	2019	0.561	2,413.0	71,470.0	2,527.0	104,004.5	−0.288
Botswana	2020	3.288	286.0	15,160.0	6,418.6	1,804.8	−0.928	Nigeria	2020	0.573	775.2	78,180.0	2,512.1	108,242.8	0.454
Botswana	2021	2.880	93.6	16,780.0	6,485.5	1,852.3	−1.143	Nigeria	2021	0.588	2,305.0	83,120.0	2,505.5	112,560.7	−0.268
Botswana	2022	2.263	31.8	17,520.0	5,810.8	1,899.7	−0.553	Nigeria	2022	0.538	2,385.0	71,570.0	2,401.2	116,965.4	−0.741
Botswana	2023	2.880	55.2	17,470.0	6,395.0	251.3	−1.142	Nigeria	2023	0.561	3,313.0	74,710.0	2,429.6	112,560.7	−0.743
DR Congo	1990	1.100	1,879.0	6,752.0	2,392.7	0.0	−1.735	São Tomé & P.	1990	0.353	0.2	0.0	1,068.8	52.5	−0.457
DR Congo	1991	1.047	2,891.0	7,829.0	2,493.1	0.0	−0.157	São Tomé & P.	1991	0.350	−0.1	0.0	1,078.3	55.1	−1.620
DR Congo	1992	1.117	4,280.0	9,441.0	2,347.8	0.0	−0.434	São Tomé & P.	1992	0.386	3.0	0.0	1,137.9	57.5	−0.078
DR Congo	1993	1.060	50.6	7,601.0	2,045.2	0.0	−0.330	São Tomé & P.	1993	0.378	3.8	0.0	1,148.8	59.9	−1.281
DR Congo	1994	1.018	4,417.0	4,253.0	1,909.4	0.0	−0.002	São Tomé & P.	1994	0.353	3.0	0.0	1,194.6	62.3	−1.281
DR Congo	1995	1.143	4,315.0	3,166.0	1,774.6	0.0	−0.317	São Tomé & P.	1995	0.350	3.6	0.0	1,268.8	64.7	−0.567
DR Congo	1996	1.258	−1,428.0	3,013.0	1,731.8	0.0	−0.195	São Tomé & P.	1996	0.357	0.3	0.0	1,283.1	67.2	1.684
DR Congo	1997	1.255	−1,983.0	1,727.0	1,586.3	0.0	−0.016	São Tomé & P.	1997	0.357	0.0	0.0	1,330.4	69.6	0.820
DR Congo	1998	0.034	3,691.0	1,887.0	1,515.9	0.0	−0.554	São Tomé & P.	1998	0.351	0.3	0.0	1,331.2	72.0	0.225
DR Congo	1999	0.031	94.2	2,041.0	1,504.7	0.0	−0.824	São Tomé & P.	1999	0.345	0.4	0.0	1,388.7	74.4	0.845
DR Congo	2000	0.050	61.3	643.5	404.1	0.0	−0.770	São Tomé & P.	2000	0.365	4.2	0.0	1,419.3	76.8	−1.187
DR Congo	2001	0.044	11.2	854.0	376.0	0.0	−1.570	São Tomé & P.	2001	0.360	3.0	0.0	1,434.0	79.5	−0.973
DR Congo	2002	0.034	94.2	895.9	340.0	0.0	−1.046	São Tomé & P.	2002	0.372	3.8	0.0	1,473.3	83.2	−1.434
DR Congo	2003	0.031	102.2	959.4	322.9	0.0	−0.875	São Tomé & P.	2003	0.366	3.0	0.0	1,540.1	87.3	−0.058
DR Congo	2004	0.032	187.6	1,416.0	322.4	0.0	−0.830	São Tomé & P.	2004	0.389	3.6	0.0	1,571.5	91.4	−1.166
DR Congo	2005	0.038	391.3	1,469.0	330.5	0.0	−0.710	São Tomé & P.	2005	0.429	3.4	0.0	1,137.9	95.7	−1.050
DR Congo	2006	0.035	409.0	1,378.0	342.5	0.0	−0.302	São Tomé & P.	2006	0.472	3.5	0.0	1,148.8	100.0	−1.683
DR Congo	2007	0.039	180.0	1,606.0	352.3	0.0	−1.766	São Tomé & P.	2007	0.495	15.7	0.0	1,194.6	104.5	−0.537
DR Congo	2008	0.039	256.1	1,906.0	359.4	0.0	−0.022	São Tomé & P.	2008	0.493	38.0	0.0	1,268.8	109.1	−1.202
DR Congo	2009	0.041	1,808.0	2,139.0	369.8	0.0	−1.385	São Tomé & P.	2009	0.482	36.0	0.0	1,283.1	113.7	−1.508
DR Congo	2010	0.041	1,727.0	2,276.0	380.5	0.0	−1.385	São Tomé & P.	2010	0.509	79.1	0.0	1,330.4	118.3	−0.335
DR Congo	2011	0.039	−243.2	3,777.0	379.1	0.0	−0.464	São Tomé & P.	2011	0.527	15.5	0.0	1,331.2	122.9	−0.335

 DOI: 10.64290/SIJEDS.v1i2.2

Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ	Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ
DR Congo	2012	0.040	2,742.0	4,267.0	393.0	0.0	1.734	São Tomé & P.	2012	0.564	50.6	0.0	1,388.7	127.6	−2.040
DR Congo	2013	0.044	1,596.0	7,184.0	406.2	0.0	0.734	São Tomé & P.	2013	0.540	32.2	0.0	1,419.3	132.2	−1.268
DR Congo	2014	0.040	2,892.0	7,385.0	420.6	0.0	0.583	São Tomé & P.	2014	0.625	22.5	0.0	1,434.0	136.7	−1.156
DR Congo	2015	0.054	1,698.0	7,400.0	441.0	0.0	0.900	São Tomé & P.	2015	0.626	12.2	0.0	1,473.3	141.1	−0.860
DR Congo	2016	0.068	1,500.0	7,756.0	466.4	0.0	−1.294	São Tomé & P.	2016	0.604	26.5	0.0	1,540.1	145.5	−0.731
DR Congo	2017	0.041	1,166.0	7,025.0	482.1	0.0	−1.024	São Tomé & P.	2017	0.615	27.9	0.0	1,571.5	149.7	−0.328
DR Congo	2018	0.030	932.4	7,743.0	476.8	0.0	−1.487	São Tomé & P.	2018	0.629	23.3	0.0	1,608.9	153.9	0.683
DR Congo	2019	0.034	1,048.0	12,760.0	477.8	0.0	−0.078	São Tomé & P.	2019	0.646	34.2	0.0	1,643.5	157.9	−0.170
DR Congo	2020	0.032	1,408.0	16,180.0	489.4	0.0	−1.001	São Tomé & P.	2020	0.651	23.7	0.0	1,665.4	162.6	−0.619
DR Congo	2021	0.034	1,351.0	13,170.0	494.8	0.0	−1.026	São Tomé & P.	2021	0.653	24.2	0.0	1,676.4	167.5	−0.641
DR Congo	2022	0.033	1,498.0	15,130.0	487.4	0.0	−1.705	São Tomé & P.	2022	0.645	47.1	0.0	1,695.2	172.3	−0.494
DR Congo	2023	0.034	1,678.0	22,650.0	501.2	0.0	−0.267	São Tomé & P.	2023	0.653	59.0	0.0	1,692.4	172.3	−0.612
Eq. Guinea	1990	1.873	0.5	3,548.0	420.5	0.0	−1.214	Sierra Leone	1990	0.076	−23.1	192.4	562.9	1,438.3	−0.510
Eq. Guinea	1991	1.945	0.9	4,490.0	414.9	161.8	−1.214	Sierra Leone	1991	0.081	22.4	193.6	553.0	1,466.0	−0.492
Eq. Guinea	1992	0.150	11.1	5,935.0	394.4	172.7	−0.298	Sierra Leone	1992	0.074	32.4	243.5	549.6	1,450.5	−2.202
Eq. Guinea	1993	0.150	41.3	6,038.0	373.2	184.3	−2.068	Sierra Leone	1993	0.078	7.5	235.9	555.7	1,458.6	−0.642
Eq. Guinea	1994	1.799	6.0	6,108.0	355.9	196.6	−2.068	Sierra Leone	1994	0.076	−5.6	232.4	458.1	1,475.4	−1.590
Eq. Guinea	1995	1.873	22.3	6,369.0	462.2	209.7	−0.991	Sierra Leone	1995	0.076	−7.5	231.4	465.0	1,488.8	−0.456
Eq. Guinea	1996	1.945	17.0	8,687.0	494.5	227.1	−1.233	Sierra Leone	1996	0.081	−2.9	255.8	453.9	1,507.1	−0.614
Eq. Guinea	1997	1.992	126.9	5,914.0	555.8	245.8	−0.946	Sierra Leone	1997	0.055	7.3	909.8	416.7	1,537.6	−0.560
Eq. Guinea	1998	2.103	376.2	5,346.0	628.9	265.8	−0.669	Sierra Leone	1998	0.071	0.7	1,286.0	421.8	1,563.9	−0.183
Eq. Guinea	1999	2.787	53.5	3,257.0	1,008.3	287.3	−0.177	Sierra Leone	1999	0.052	1.8	1,053.0	391.8	1,583.5	−0.377
Eq. Guinea	2000	3.258	274.8	1,841.0	2,424.8	310.2	0.457	Sierra Leone	2000	0.056	0.1	810.5	394.7	1,633.1	−0.260
Eq. Guinea	2001	5.049	154.3	1,626.0	2,886.2	336.3	−0.150	Sierra Leone	2001	0.044	0.5	769.6	384.8	1,742.1	−0.365
Eq. Guinea	2002	2.894	154.5	1,440.0	3,486.8	365.6	−0.415	Sierra Leone	2002	0.073	39.0	810.5	400.6	1,856.0	−0.955
Eq. Guinea	2003	4.022	940.7	1,152.0	3,941.7	396.5	−0.761	Sierra Leone	2003	0.091	9.8	130.9	354.1	1,945.2	−1.037
Eq. Guinea	2004	3.373	323.4	412.7	6,132.8	428.9	−0.532	Sierra Leone	2004	0.097	10.4	165.7	423.3	2,025.0	−0.412
Eq. Guinea	2005	3.540	689.8	2,381.0	6,987.9	463.0	−0.661	Sierra Leone	2005	0.103	8.6	192.4	445.2	2,098.2	−1.101
Eq. Guinea	2006	6.677	340.9	6,108.0	7,604.5	499.3	−1.799	Sierra Leone	2006	0.096	61.2	193.6	458.4	2,167.2	−1.124
Eq. Guinea	2007	6.487	769.1	6,369.0	10,028.4	538.1	−0.574	Sierra Leone	2007	0.079	90.7	243.5	465.8	2,238.4	−0.793
Eq. Guinea	2008	6.168	469.5	2,735.0	11,188.4	579.7	−1.605	Sierra Leone	2008	0.102	58.9	235.9	475.2	2,319.2	−0.842
Eq. Guinea	2009	6.667	1,243.0	3,548.0	11,508.9	624.3	−0.138	Sierra Leone	2009	0.085	95.5	232.4	501.9	2,407.9	−0.342
Eq. Guinea	2010	5.845	−793.9	4,490.0	12,660.9	671.7	−0.527	Sierra Leone	2010	0.085	53.1	231.4	516.0	2,501.0	−0.453
Eq. Guinea	2011	5.812	1,636.0	5,935.0	14,222.5	721.7	−0.578	Sierra Leone	2011	0.083	110.4	255.8	518.2	2,595.2	−1.489
Eq. Guinea	2012	5.526	2,734.0	6,038.0	13,740.8	772.5	−0.508	Sierra Leone	2012	0.087	238.4	909.8	537.4	2,691.1	−0.438
Eq. Guinea	2013	5.320	1,975.0	6,108.0	11,933.3	823.6	0.173	Sierra Leone	2013	0.111	950.5	1,286.0	554.5	2,788.5	−1.385
Eq. Guinea	2014	4.917	985.3	6,369.0	12,155.8	865.1	−0.271	Sierra Leone	2014	0.126	722.4	1,053.0	622.3	2,887.1	−1.385
Eq. Guinea	2015	4.815	582.9	8,687.0	12,625.3	907.7	−0.260	Sierra Leone	2015	0.148	429.7	810.5	734.4	2,986.5	−0.668
Eq. Guinea	2016	4.591	167.9	5,914.0	11,614.0	951.2	−0.420	Sierra Leone	2016	0.159	375.1	769.6	748.9	3,089.6	1.495
Eq. Guinea	2017	4.079	233.3	5,346.0	11,200.8	995.2	−1.114	Sierra Leone	2017	0.148	252.4	655.1	581.3	3,196.6	0.747
Eq. Guinea	2018	4.168	54.0	3,257.0	9,789.0	1,039.4	−0.773	Sierra Leone	2018	0.156	138.5	709.4	603.4	3,306.1	0.174
Eq. Guinea	2019	3.701	304.8	1,841.0	8,594.5	1,083.7	−1.348	Sierra Leone	2019	0.146	413.7	739.5	611.1	3,418.6	0.610
Eq. Guinea	2020	3.374	396.1	1,626.0	7,818.1	1,127.9	−0.881	Sierra Leone	2020	0.133	250.4	495.6	617.5	3,534.3	−1.156
Eq. Guinea	2021	3.140	452.3	1,440.0	7,079.7	1,166.7	−1.179	Sierra Leone	2021	0.129	342.4	500.8	635.0	3,652.2	−0.842
Eq. Guinea	2022	2.726	529.9	1,152.0	6,472.1	1,202.3	−0.786	Sierra Leone	2022	0.127	172.7	454.4	608.3	3,772.0	−1.505
Eq. Guinea	2023	3.140	491.1	412.7	6,030.5	1,239.6	−0.575	Sierra Leone	2023	0.129	212.3	458.8	619.3	562.5	−0.301
Lesotho	1990	0.819	13.7	57.5	280.4	251.3	−0.980	South Africa	1990	6.209	−201.2	24,240.0	4,803.6	0.0	−1.446
Lesotho	1991	0.829	16.5	80.3	331.5	265.8	−0.948	South Africa	1991	6.209	−75.7	21,480.0	4,643.2	0.0	−0.561
Lesotho	1992	0.776	8.0	102.7	385.0	280.7	−0.920	South Africa	1992	6.209	254.1	21,330.0	4,479.9	0.0	−1.223
Lesotho	1993	0.791	8.4	156.0	447.1	296.1	−0.500	South Africa	1993	5.922	3.4	20,030.0	4,294.9	0.0	−1.153
Lesotho	1994	0.809	15.7	192.0	443.2	311.8	−0.408	South Africa	1994	5.718	11.3	19,980.0	4,269.7	0.0	−1.282
Lesotho	1995	0.819	43.3	197.7	459.7	327.9	−1.463	South Africa	1995	5.795	374.4	24,170.0	4,330.7	0.0	−0.739

 DOI: 10.64290/SIJEDS.v1i2.2

Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ	Country	Year	EF	FDI ($m)	GCF ($m)	GDPpc	URP (000)	INQ
Lesotho	1996	0.829	24.2	228.4	518.0	343.5	−0.213	South Africa	1996	5.826	1,248.0	27,610.0	4,392.1	0.0	−1.240
Lesotho	1997	0.835	29.1	295.5	483.9	356.0	−1.205	South Africa	1997	6.008	816.4	27,890.0	4,511.6	0.0	−2.084
Lesotho	1998	0.841	32.7	343.9	505.9	368.1	−0.716	South Africa	1998	6.136	3,811.0	28,710.0	4,565.2	0.0	−0.374
Lesotho	1999	0.849	28.4	316.1	467.6	379.7	−0.716	South Africa	1999	6.373	550.3	29,670.0	4,531.3	0.0	1.147
Lesotho	2000	0.859	22.0	283.7	457.7	390.7	1.645	South Africa	2000	6.460	1,503.0	28,740.0	4,588.8	0.0	−2.548
Lesotho	2001	0.865	32.4	359.1	443.9	401.2	0.596	South Africa	2001	6.002	968.8	29,750.0	4,735.7	0.0	−1.462
Lesotho	2002	0.874	29.7	289.9	413.0	411.4	0.046	South Africa	2002	6.077	7,270.0	29,890.0	4,820.6	0.0	−0.899
Lesotho	2003	0.886	28.4	297.4	388.4	421.3	0.633	South Africa	2003	6.784	1,480.0	32,550.0	4,953.7	0.0	−0.532
Lesotho	2004	0.902	43.9	292.7	580.9	430.6	−1.075	South Africa	2004	6.951	783.1	36,280.0	5,052.9	0.1	−0.724
Lesotho	2005	0.916	55.7	300.8	761.2	440.0	−0.837	South Africa	2005	7.339	701.4	42,070.0	5,233.9	0.0	−0.277
Lesotho	2006	0.943	27.4	278.0	850.8	451.1	−1.453	South Africa	2006	7.825	6,522.0	44,800.0	5,458.2	0.0	−0.050
Lesotho	2007	0.962	24.3	250.6	910.6	462.2	−0.383	South Africa	2007	7.704	623.3	50,520.0	5,708.8	0.0	−0.256
Lesotho	2008	0.973	75.6	261.8	848.0	474.7	−1.172	South Africa	2008	7.673	6,587.0	54,880.0	5,954.2	0.1	−0.513
Lesotho	2009	0.988	11.0	367.4	885.6	488.1	−1.118	South Africa	2009	7.944	9,885.0	59,710.0	6,074.9	0.1	−0.509
Lesotho	2010	1.006	91.3	464.3	866.4	501.6	−1.255	South Africa	2010	8.447	7,624.0	54,680.0	5,910.8	0.1	−0.543
Lesotho	2011	1.046	9.5	498.3	1,104.8	515.7	−0.817	South Africa	2011	7.902	3,693.0	55,100.0	6,018.2	0.0	−0.544
Lesotho	2012	1.067	61.2	555.5	1,265.9	528.1	−1.228	South Africa	2012	8.218	4,139.0	61,560.0	6,131.0	0.1	−2.065
Lesotho	2013	1.416	56.7	512.9	1,205.9	541.3	−2.019	South Africa	2013	7.808	4,626.0	61,120.0	6,195.0	0.1	−0.555
Lesotho	2014	1.421	50.4	727.6	1,141.4	555.3	−0.287	South Africa	2014	8.035	8,233.0	64,180.0	6,263.1	0.1	−1.274
Lesotho	2015	1.064	94.5	686.8	1,165.1	570.1	1.128	South Africa	2015	8.116	5,792.0	62,120.0	6,252.3	0.1	−0.229
Lesotho	2016	1.121	206.5	758.2	1,113.9	585.6	−2.433	South Africa	2016	8.191	1,521.0	64,600.0	6,204.9	0.1	−0.493
Lesotho	2017	1.012	79.2	718.2	986.3	601.9	−1.439	South Africa	2017	7.607	2,215.0	59,190.0	6,185.7	0.1	−0.424
Lesotho	2018	0.992	42.2	732.9	1,062.7	618.8	−0.983	South Africa	2018	7.545	2,059.0	60,950.0	6,233.2	0.1	−0.111
Lesotho	2019	1.107	40.9	555.7	1,163.0	636.2	−0.692	South Africa	2019	7.684	5,569.0	60,190.0	6,251.0	0.1	−0.678
Lesotho	2020	1.036	35.7	586.6	1,094.5	654.3	−0.780	South Africa	2020	7.667	5,116.0	60,040.0	6,189.3	0.1	−0.348
Lesotho	2021	1.033	28.0	702.3	939.5	672.6	−0.318	South Africa	2021	7.689	3,154.0	44,810.0	5,726.3	0.1	−0.189
Lesotho	2022	1.026	−12.4	625.2	1,040.3	690.4	0.013	South Africa	2022	6.688	41,300.0	47,950.0	5,947.9	0.1	−0.930
Lesotho	2023	1.033	−7.8	702.3	1,107.4	690.4	−0.251	South Africa	2023	6.688	8,803.0	54,740.0	6,018.5	0.1	−1.166