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Article

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Ecological footprint and human well-being nexus: accounting for broad-based financial development, globalization, and natural resources in the Next-11 countries

Solomon Prince Nathaniel^{1,2*}

Abstract

The Next-11 (N11) countries have witnessed great advancements in economic activities in the past few years. However, the simultaneous attainment of environmental sustainability and improved human well-being has remained elusive. This study probes into ecological footprint (EF) and human well-being nexus in N11 countries by applying advanced estimation techniques compatible with heterogeneity, endogeneity, and cross-sectional dependence across country groups. From the findings, human well-being, captured by the human development index, increases the EF, and EF also increases human well-being which suggests a strong trade-off between both indicators. This shows that policies that are channeled toward promoting human well-being are not in consonance with environmental wellness. Financial development and biocapacity increase the EF, while natural resources and globalization reduce it. Human well-being increases the EF in all the countries except in Egypt. This study argues that strong institutions could help mitigate the trade-offs and ease the simultaneous attainment of both environmental preservation and improved human well-being. The limitations of the study, as well as, possible directions for future research are discussed.

Keywords: Human well-being, Globalization, Ecological footprint, Financial development, Sustainable development, AMG

Introduction

Environmental matters are now a serious issue and are gaining more popularity by the passing of each day. But, the challenge of maintaining a sustainable environment without inhibiting human well-being is still ubiquitous. Many factors have been found culpable of environmental degradation, but the human factor, is most often than not, ignored. However, human factors are the major drivers of ecological distortions [42, 43, 52, 53]. The link between ecological conditions and human well-being cannot be overemphasized. Better environmental

management, could, in principle, come with lots of good outcomes for humanity, with a positive synergy between human well-being and environmental conditions [41]. A positive synergy between human well-being and environmental quality is quite ideal and desirable, but it would be erroneous to believe that both are, or should be mutually reinforcing. A trade-off is expected especially in a situation where environmental and growth policies are not well-designed [75]. It is most likely that variables/factors like urbanization, globalization, energy consumption, and natural resources exploration can promote ecological distortions and increase the demands for health, food, education, and wealth which are core human development elements [2, 5, 6, 44, 47, 54, 72].

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The United Nations rolled out the Sustainable Development Goals (SDGs) in 2015 and listed; Quality Education (Goal 4), No Poverty (Goal 1), Climate Action (Goal 13), Good Health and Well-Being (Goal 3), Zero Hunger (Goal 2), Reduced Inequality (Goal 10), Life on Land (Goal 15), etc., as some of the tenets of the SDGs. The idea behind these goals is to improve human well-being and place humans at a level where they can efficiently contribute to environmental wellness. However, the improvement of human well-being in some of the N11 countries is still in a pitiable state. Also, the simultaneous attainment of Goal 3 and Goal 15 still remains elusive.

Though these countries (N11) have witnessed persistent growth in their GDP over the years, there are still some key issues capable of declining human well-being that is yet to be appropriately addressed. As such, the Human Development Index (HDI) of these countries has witnessed little or no improvement. See Table 1.

Table 1 reveals that all the countries have their EF higher than their BIO, inferring ecological deficit. Korea has the highest HDI, and also the worst environmental records, as the country’s EF is exceedingly higher than its BIO. A closer look at Table 1 reveals that each country has witnessed an increase in its HDI between the time periods. The questions begging for answers remain; is there a trade-off between human well-being and environmental quality in the N11 countries? Does the drain in biocapacity, or drench in EF influence human well-being in the N11 countries? What is the influence of globalization on human well-being in the N11 countries? This study will assist policymakers in these countries to align their objectives of improving human well-being and the quality of life, with that of preserving the natural ecosystems.

Attaining human well-being without deteriorating environmental quality is required in N11 countries. A better understanding of how both are connected is of utmost importance in these countries. This knowledge will inform a desirable human well-being development plan that will enhance sustainable growth and maintain environmental quality. This study is super useful for the N11 countries where factors like globalization, economic growth, urbanization, financial development, and other socio-economic conditions are depleting the biocapacity, causing resource depletion, and increasing the regions ecological footprint (EF). Of little wonder, all the N11 countries are now occupying an ecological deficit territory. Figure 1 presents the study framework.

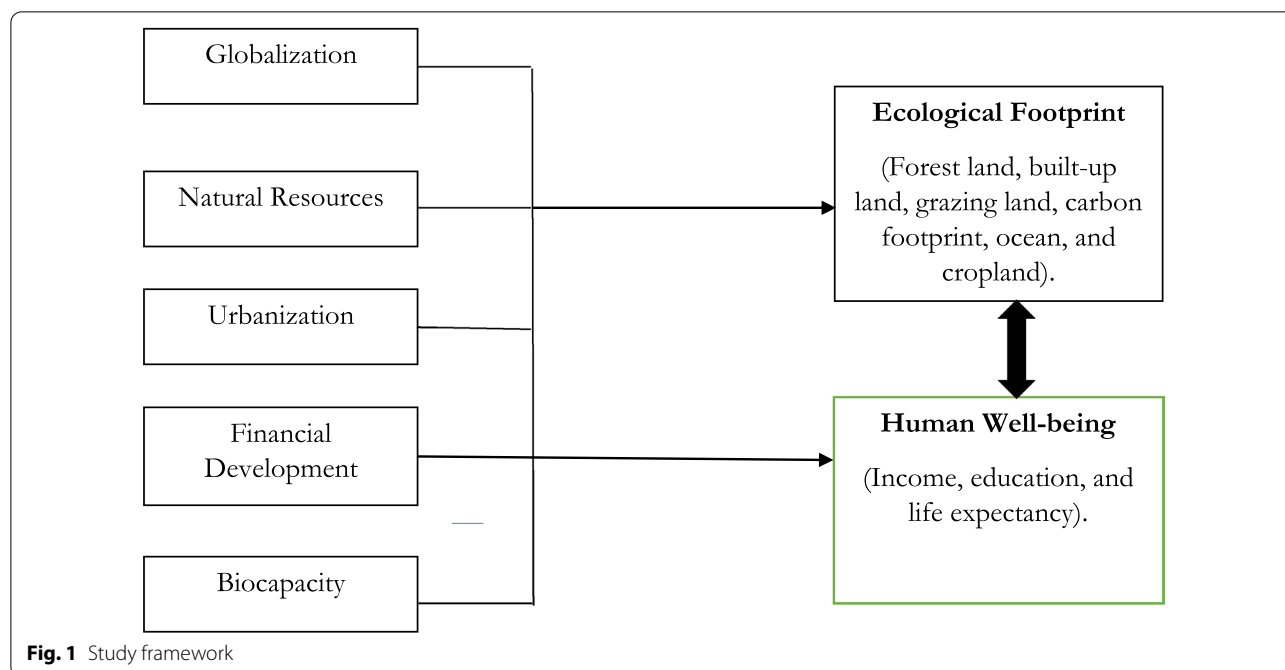
Energy consumption, natural resources exploration, and financial development may have consequences on the quality of the environment [16]. Financial development instigates higher loan disbursement to customers at low costs. This access to funding gives the firm the opportunity to create demand for their outputs thereby promoting industrialization [86]. Industrialization stimulates urbanization and energy consumption which gives room for ambient air pollution. Also, air pollution hampers human well-being by creating sickness, infant mortality, and other health defects [51]. At the early stage of financial development, emissions level is expected to rise. However, as financial development persists, emissions decline since the former promotes energy innovations, which might result in energy generation from cleaner sources [86, 87].

This study contributes from the following angles: (1) this is the pioneer study to examine the influence of biocapacity, EF, and financial development on human well-being in the N11 countries. (2) This study employs

Table 1 Biocapacity, ecological footprint, and HDI in the N11 countries. Sources Global Footprint Network [25] and UNDP [76]

Countries	2014			2015			2016		
	EF	BIO	HDI	EF	BIO	HDI	EF	BIO	HDI
Bangladesh	0.80	0.40	0.57	0.87	0.40	0.58	0.84	0.40	0.59
Egypt	1.96	0.45	0.68	1.91	0.45	0.69	1.81	0.44	0.69
Indonesia	1.68	1.26	0.69	1.63	1.27	0.69	1.68	1.22	0.70
Iran	3.34	0.74	0.78	3.23	0.75	0.78	3.19	0.73	0.79
South Korea	5.73	0.67	0.89	5.85	0.67	0.89	6.00	0.66	0.90
Mexico	2.57	1.20	0.75	2.56	1.16	0.75	2.60	1.17	0.76
Nigeria	1.17	0.70	0.52	1.13	0.70	0.52	1.08	0.68	0.52
Pakistan	0.82	0.38	0.54	0.81	0.36	0.55	0.83	0.36	0.55
Philippines	1.09	0.57	0.69	1.15	0.56	0.70	1.32	0.54	0.70
Turkey	3.25	1.44	0.79	3.34	1.50	0.80	3.35	1.43	0.80
Vietnam	1.78	1.02	0.67	2.01	1.05	0.68	2.12	1.01	0.68

BIO biocapacity



a positive and comprehensive environmental indicator (EF) that accommodates forest land, built-up land, grazing land, carbon footprint, ocean, and cropland. Furthermore, second-generation econometric techniques have been employed to address heterogeneity, endogeneity, and CD. (3) The augmented mean group (AMG) estimator, Driscoll–Kraay (DK), Panel-corrected standard error (PCSE), and the cross-sectionally augmented autoregressive distributed lag (CS-ARDL) model approach are applied to achieve robust estimates which can inform policy formulation that will enhance environmental sustainability and the improvement of human well-being in general, and N11 countries in particular.

This study is arranged thus: “Literature review” section presents the literature, and “Methodology, model, and data source” section addresses the methodology and data source. Results are presented and discussed in “Results” section. “Conclusions” section concludes.

Literature review

Theoretical background/underpinning

Gross domestic product (GDP) has been widely used as a measure of economic wellness. The GDP is just the monetary value of goods and services produced within a country, usually for 1 year. This metric (GDP) has its limitations as it fails to capture human welfare, health impairment, and education relating to environmental awareness [17]. The intuition here is clear; there is a need for an all-embracing metric that addresses welfare effects, accounts for society’s education, income, and health in

the environmental quality-welfare debate. For this reason, the HDI meets our demand. There are studies in the literature that support a positive association between education and life expectancy (both components of HDI) and environmental disasters but failed to establish the same association between the aforementioned variables and GDP [13].

The EF is a relatively new concept, and it appears that only a few studies have used this tool to measure human well-being activities impact the environment. As such, limited research has been completed on human well-being as it relates to environmental sustainability. Theoretically, studies in the past have tried to develop an index that addresses social-economic and environmental difficulties (see, for instance, [12]). The two theories that evolve from such integrated sustainable HDI are the win–win and the trade-off approach. The win–win approach believes society/community can achieve double benefits of improved environmental quality and well-being, while the trade-off approach argued that both are not self-enforcing that a trade-off is inevitable. This study intends to examine both approaches for the N11 countries with EF as the environmental indicator and HDI as the human well-being indicator. The EF measures mankind’s demand for the regenerative capacity of our planet: Earth’s biocapacity [21]. Apart from being an accounting tool, the EF is an area-based indicator that measures the intensity by which humans use resources and generate waste, relative to that area’s capacity to provide for these activities. It is also referred to as “appropriated carrying

capacity” since every person appropriates the productive capacity of nature [15, 23]. It is expected that the outcome of this study will give insight and propose policy directions that will balance these two targets (human well-being and environmental wellness) simultaneously in the N11 countries.

HDI, globalization, biocapacity, and ecological footprint

Most recent studies have tried to link HDI/human development to economic growth and financial development (see, [26, 73]). However, the possibility abounds that HDI can also impact the EF. Environmental pollution and a fragile ecological environment impairs human well-being and health and causes ecological distortions [11, 89]. Environmental degradation affects human well-being adversely and inhibits ecological balance. Also, the desire to improve the quality of life exacts pressure on the natural environment which in turn reduces the bio-productive land. Ahmed et al. [7] examined if human capital reduces the EF in G7 countries. The outcome was in the affirmative. The authors further noted that the level of human development matters for environmental wellness. Zafar et al. [85] explored the impact of human capital on the EF in the USA for the period 1970–2015 through the ARDL approach. Their findings suggest human capital that reduces the EF. Ahmed et al. [4] used the same approach as Zafar et al. [85] and also discovered a similar relationship between human capital and EF in China. Kassouri and Altıntaş [31] discovered that biocapacity and globalization reduce the EF after applying the Interactive Fixed Effects estimator on a panel of 13 MENA countries.

There are studies that have tried to link globalization with environmental quality. Shahbaz et al. [67] used the GMM technique to examine the influence of institution, globalization, and trade on the environment in the G7 countries from 1980 to 2014. They discovered that globalization harms the environment. In a similar gesture, Liu et al. [39] explored the effect of renewable energy and globalization on the quality of the environment in G7 countries between 1970 and 2015. From their findings, renewable energy adds to environmental quality, while globalization promotes pollution. Acheampong et al. [1] arrived at a similar result as regards the devastating impact of globalization on the environment in sub-Saharan Africa (SSA). The findings of Shahbaz et al. [67], Liu et al. [39], and Acheampong et al. [1] contradict the recent findings of Saud et al. [66] who discovered that globalization mitigated the EF in one-belt-one-road (OBOR) initiative countries.

Hassan et al. [27] used the ARDL approach to investigate the impact of biocapacity, human capital, and growth on the EF in Pakistan. Biocapacity and economic growth

influence the environment negatively, while human capital declines the EF. Hassan et al. [28] further probed the influence of natural resource and biocapacity on the EF in Pakistan. The ARDL results revealed that biocapacity and natural resource increase EF. Also, causality flows from both variables to the EF. Pandey et al. [57] investigated the impact of biocapacity and globalization on the environment in Asia from 1971 to 2014. In contrast to the findings of Shahbaz et al. [67] and Acheampong et al. [1], they discovered that globalization promotes environmental quality, while biocapacity exacts a reverse influence on environmental quality.

Financial development, urbanization, economic growth, and ecological footprint

There is an on-going gradual transition from the use of CO₂ emissions as an environmental indicator to EF in the cause of measuring the impact of financial development, urbanization, and economic growth on the environment. Zafar et al. [85] and Ahmed et al. [4] used the ARDL technique to investigate the impact of economic growth on the EF in the USA and China, respectively. Both studies agreed that economic growth increases the EF. Ahmed et al. [4] further reported that urbanization contributes to ecological pressure in China. Ahmed et al. [4] argued that urbanization in China is not sustainable and therefore called on policymakers to enact legislation that will enhance urban sustainability considering the population growth rate in China. Nathaniel et al. [49] investigated the interaction between economic growth, urbanization, and EF in CIVETS nations. The AMG estimator was employed. Long-run interaction was found among the variables. Economic growth decreases environmental deterioration, while urbanization increases it in CIVETS countries. Nathaniel et al. [50] studied the effect of urbanization on the EF in the MENA nations. They adopted the AMG algorithm for their study. The result indicated that urbanization and economic growth add to environmental deterioration. Further findings affirmed a one-way directional causality from urbanization and economic growth to the EF in MENA nations.

Saud et al. [66] applied the PMG approach to investigate the impact of globalization and financial development on the EF in OBOR countries from 1990 to 2014. Their findings affirmed that financial development increases the EF, while globalization reduces it. Ansari et al. [9] investigated the impact of economic growth on material footprint and EF in 37 Asian countries from 1991 to 2017 using the PMG, GMM, and DOLS techniques. Their findings showed that economic growth increases both indicators (material footprint and EF). Sharif et al. [68] also discovered that economic growth drives the EF in Turkey. Kassouri and Altıntaş [31]

explored the effect of financial development and urbanization on EF in MENA countries. They discovered that both variables increase EF, but exact the opposite influence on human well-being.

In conclusion, the literature survey reveals that studies seldom examine the effects of HDI on EF. More so, there is no single study that has investigated the impact of HDI on the EF in N11 countries. The recently introduced financial development index by the IMF has never been used for any analysis that involves the N11 countries. This is the only study that tried to examine the existence of the win-win or trade-off hypothesis in N11 countries. The effect of urbanization, financial development, and globalization on the EF is still murky as consistency in findings remains elusive.

Methodology, model and data source

Methods

This study adopts econometric procedures that are consistent with the properties of the data used in the study. A wrong procedure will yield bias and inconsistent estimates. To avoid such outcomes, this study proceeds with the CD test.

Cross-sectional dependence

As earlier mentioned, results could be biased if CD is ignored. Earlier studies failed to consider the possibility of CD in their empirical analysis; knowing fully well that the world is now a global village where countries are closely knitted. CD is now common due to spillover effect, financial crisis, trade agreements, and international treaties, among others. As such, this study applies the CD tests suggested by Pesaran [60] given as:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=0}^{N-1} \sum_{j=i+1}^{N-1} \rho_{ij} \right) N(0, 1) \tag{1}$$

where ρ_{ij} = cross sections correlation of error between i and j . T is the time horizon, and N represents cross sections. This study will be more concerned with the first two tests because they are robust in panels where T (time dimension) $>$ N (cross section); which is the exact feature of our dataset.

Unit root

Apart from the CD tests, the integration properties of the data are also necessary. The presence of CD will determine the choice of the unit root tests. Second-generation tests are preferred in the vicinity of CD. Therefore, this study used the cross-sectionally augmented ADF (CADF) and cross-sectionally augmented IPS (CIPS) introduced by Pesaran [61]. Both tests account for CD and heterogeneity. Pesaran [61] suggested a Dickey-Fuller based tests (CADF)

that is consistent with structural breaks, heterogeneity and CD. The CADF test equation is given as:

$$\Delta y_{it} = \Delta \varphi_{it} + \beta_i x_{it-1} + \rho_i T + \sum_{j=1}^n \theta_{ij} \Delta x_{i,t-j} + \varepsilon_{it} \tag{2}$$

ρ_i is the proxy of the unobservable common factor which Pesaran [61] introduced to eliminate CD emanating from common shocks that might affect all the units. Also, Pesaran [61] suggested a cross-sectional augmented version of the IPS test given as:

$$CIPS = \frac{1}{N} \sum_{j=1}^N CADF_t \tag{3}$$

Both tests (CADF and CIPS) have unique properties. They can address serial correlation and perform better than all the first-generation tests.

Cointegration

When variables have the same order of integration, let us say, $I(1)$, it becomes necessary to ascertain if they have a long-run relation. The study applies the Westerlund [79] test to investigate the possibility of a cointegrating relationship among the variables. The test controls for CD and nuisance arising from endogeneity. It has a greater explanatory power compared to dynamic cointegration tests. Westerlund [79] constructed four statistics. Two of the four statistics are the group mean statistics,

$$G_\tau = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \text{ and } G_\alpha = \frac{1}{N} \sum_{i=1}^N \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \tag{4}$$

which tests the cointegration of the whole panel, and the panel mean tests,

$$P_\tau = \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \text{ and } P_\alpha = T\hat{\alpha} \tag{5}$$

which examines the existence of cointegration in at least one of the units. The test applies bootstrap approach to account for CD and non-strictly exogenous regressors.

Parameter estimation

The current study adopted the AMG estimator of Bond and Eberhardt [14] because it is consistent with the characteristics of our data. Also, it accounts for heterogeneity and CD which are the two core panel data issues [19]. The AMG is performed in two stages:

$$AMG\text{-Stage1: } \Delta y_{it} = \alpha_i + b_1 \Delta x_{it} + c_1 f_t + \sum_{t=2}^T d_t \Delta D_t + e_{it} \tag{6}$$

$$\text{AMG-Stage2: } \hat{b}_{\text{AMG}} = N^{-1} \sum_{i=1}^N \hat{b}_i \quad (7)$$

x_{it} and y_{it} are the observables. f_t represents the unobserved common factor. The country-specific estimates of coefficients, the AMG estimator, and the time dummies are, respectively b_t , \hat{b}_{AMG} , and d_t . In addition, the DK, CS-ARDL, and the PCSE approach are used to ascertain the robustness of the findings. The DK is robust amidst serial and spatial dependence, heteroscedasticity, and CD. It accommodates balanced and unbalanced panels, both large and small sample sizes, and missing values [10]. The PCSE shares almost the same properties with the DK approach. Besides, the CS-ARDL accommodates non-stationary data, and is capable of addressing CD and endogeneity issues [3].

Causality

One limitation of the AMG estimator is that it does not give information about causality. Since the direction of causality aids policy direction, the Dumitrescu and Hurlin [20] test is applied to check the direction of causality. The DH equation is given as:

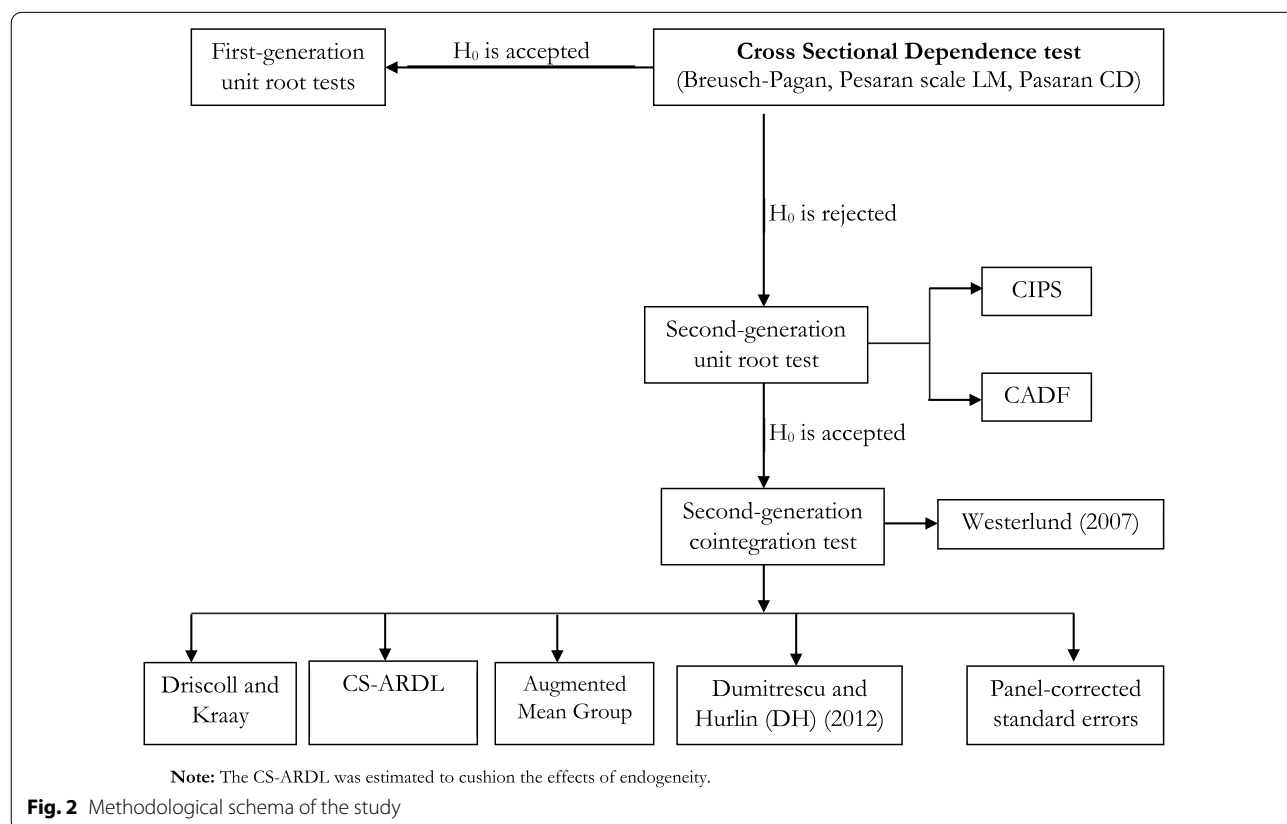
$$y_{i,t} = \varsigma_i + \sum_{i=1}^p \xi_i^{(p)} y_{i,t-n} + \sum_{i=1}^p \pi_i^{(p)} x_{i,t-n} + \mu_{i,t} \quad (8)$$

The intercept and coefficient ς_i and $\pi_i = (\pi_i^{(1)}, \dots, \pi_i^{(p)})$ are fixed. The autoregressive parameter and regression coefficient are, respectively $\xi_i^{(p)}$ and $\pi_i^{(p)}$ (Fig. 2).

Data and model

The study made use of annual data spanning 1990–2016 for N11 countries; a decision informed by data availability. The variables have been carefully selected with respect to economic theory, data availability, and empirical literature. Two core sustainability indicators (HDI and EF) have been used. The EF has been widely embraced as a comprehensive environmental indicator [45, 46, 49, 50, 52]. The EF is superior to other metrics as it goes further to show how production, investment, and consumption inhabit the regenerative capacity of the Earth [55].

On the other hand, the HDI, designed by the UNDP, is a composite index that englobes three components (adult literacy, per capita gross national income, and life expectancy at birth). Today, the HDI is widely used as an indicator of human well-being [40, 65], though it has its limitation. See the concluding section of this study for the limitations of HDI as an indicator of human well-being. Unlike previous studies that



used the ratio of private credit to GDP, the ratio of current liabilities to GDP, and the ratio of deposits and loans to GDP to measure financial development, the current study used a broad-based financial development index recently introduced by the IMF. This index is way superior to those used by earlier studies in that, it considers the complex multidimensional nature of financial development. It summarizes how developed financial institutions and financial markets are, in terms of access, depth, and efficiency. See Sahay et al. [64] for more information on the index. However, recent studies like Iorember et al. [30] and Kassouri and Altıntaş [31] have used this index. The development of the financial system is associated with access to funds. When people have access to funding, they are more like to consume renewables, hence an improvement in environmental quality. Unsustainable natural resource consumption and exploration reduce the biocapacity, deplete forest, and cause the EF to rise [46]. Despite its contribution to knowledge, innovation, and economic development, urbanization spreads emissions, negatively impacts local food production [80], decreases soil fertility [8], and generates environmental degradation. Globalization opens up the economy and allows for the importation of products, and technologies that could improve human well-being or add to the already existing emissions level [70].

To investigate whether the win–win or trade-off hypothesis is evident in N11 countries, we need to estimate the effect of EF on HDI, and HDI on EF. This study further considered the role of globalization, financial development, urbanization, biocapacity, and natural resource as major determinants of sustainability. The consideration of these variables will give a clearer picture of the applicability of (SDGs 3) and (SDGs 15) simultaneously. The models for this study are:

$$\ln ef_{it} = \tau_0 + \tau_1 \ln hd_{it} + \tau_2 \ln fd_{it} + \tau_3 ub_{it} + \tau_4 \ln bi_{it} + \tau_5 \ln gb_{it} + \tau_6 nr_{it} + \mu_{i1t} \tag{9}$$

$$\ln hd_{it} = \xi_0 + \xi_1 \ln ef_{it} + \xi_2 \ln fd_{it} + \xi_3 ub_{it} + \xi_4 \ln bi_{it} + \xi_5 \ln gb_{it} + \xi_6 nr_{it} + \mu_{i2t} \tag{10}$$

$\tau_0 - \tau_6$ and $\xi_0 - \xi_6$ are the parameters to be estimated in Model 1 and 2, respectively. t and i are the time dimension and country, respectively. $i = 1, 2, \dots, 11$, and as $t = 1, 2, \dots, 27$. μ_{i1t} and μ_{i2t} are the error terms in model 1 and 2, respectively. Two variables (natural resources rent and urbanization) were not logged because these variables are already in their growth rates. See Table 2 for the measurements, symbols, and sources of the variables.

Results

This section presents the trend of the variables, descriptive statistic and correlation, CD tests, unit root tests, cointegration, and the parameter estimation results.

Trend of the variables

In Fig. 3, South Korea and Iran are the two countries with the largest EF. However, the EF appears to be relatively constant only in Pakistan and the Philippines. Figure 4 reveals declining biocapacity in almost all the countries, especially in Mexico, Indonesia, Turkey, and Iran. In Fig. 5, all the countries have witnessed an increase in their HDI over the years; suggesting improvement in human well-being. Figures 6, 7, and 8 present a clearer picture of the trend of each of these variables in the individual N11 countries (see “Appendix”). Table 3 presents the summary statistic of the variables in relation to their mean, minimum value, standard deviation, and maximum value. From the results, globalization has the highest average followed by urbanization. These show how urbanized and globalized the N11 countries

Table 2 Description of variables

S/N	Variables	Measurement	Source	Symbols
1	Ecological Footprint	global hectares per capita	GFN (2019b)	ef
2	Biocapacity	global hectares per capita	GFN [24]	bi
3	Natural resource	Natural resources rent (% of GDP)	WDI [81]	nr
4	Urbanization	% of total population	WDI [81]	ub
5	Globalization	Overall KOF index	KOF [35]	gb
6	Financial development	Broad-based index of financial depth access and efficiency	IMF [29]	fd
7	Human development index	Score	UNDP [76]	hd

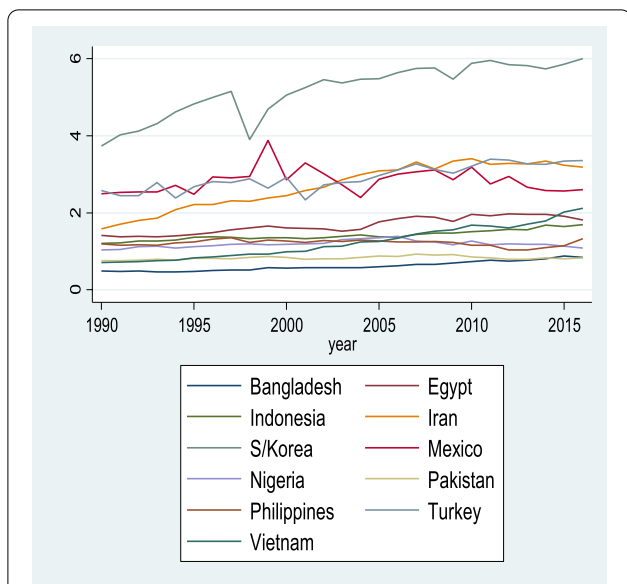


Fig. 3 EF in N11 countries

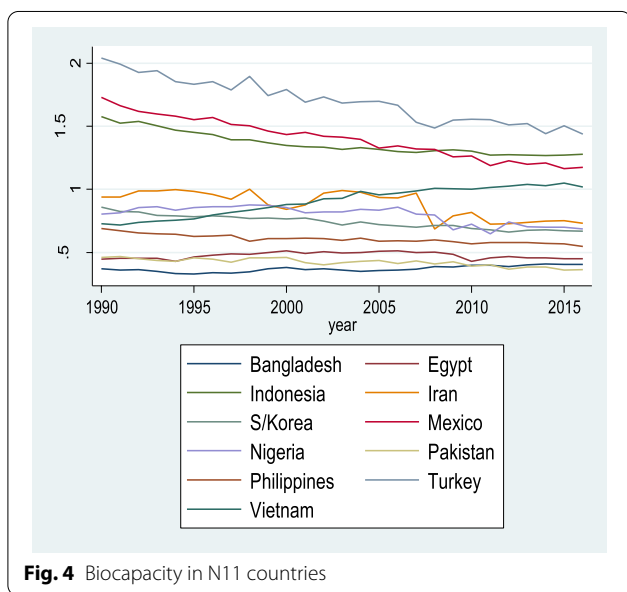


Fig. 4 Biocapacity in N11 countries

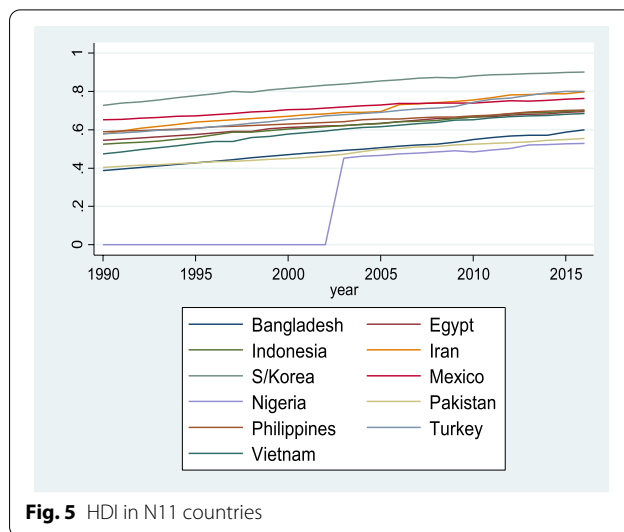


Fig. 5 HDI in N11 countries

are. Urbanization is the most volatile of the variables while financial development is the least volatile of the variables.

All the variables, except natural resources, are positively associated with EF. Apart from EF, the remaining variables show a negative correlation with natural resources. HDI, globalization, and biocapacity are positively associated with financial development and urbanization.

Table 4 confirms the presence of CD. This finding is not strange, as all the N11 countries are signatories to various environmental sustainability treaties, like the Paris Agreement of 2015. Both unit root tests (see Table 5) affirmed non-stationarity of the variables at their level form. However, the stationarity of the variables was confirmed after their first difference. With these results, we can comfortably proceed with the cointegration test.

Table 6 confirms cointegration. G_t and P_p in both models show probability values that are significant which makes it difficult to reject the null hypothesis of no cointegration. Cointegration is a prerequisite for parameter estimation. Since this condition has been met, we now proceed with the AMG and other estimations.

The findings in Table 7, Model 1, reveal that natural resources and globalization reduce the EF. A one percent increase in natural resources rent reduce the EF by 0.023%, 0.239%, and 0.412% in the AMG, PCSE, and DK estimators, respectively. The intuition here is that natural resources rent does not harm the environment in the N11 countries. Also, a one percent increase in globalization reduces the EF by 0.049%, 0.087%, and 0.085% in the AMG, PCSE, and DK estimators, respectively. The negative relationship between globalization and EF as shown in the three estimators confirmed that globalization is consistent with environmental sustainability in the N11 countries. Conversely, urbanization, biocapacity, and financial development increase EF. A one percent increase in urbanization is associated with 0.14%, 0.21%, and 0.03% increase in EF in the AMG, PCSE, and DK estimators, respectively. The nexus between financial development and EF is positive and significant across the three estimators; suggesting that financial development increases the EF by 0.02%, 0.01%, and 0.27% in the AMG,

Table 3 Descriptive statistics results

Statistics	lnEF	NR	lnFD	UB	lnBI	lnGB	lnHD
Mean	1.982	6.679	0.332	47.72	0.878	54.81	0.602
SD	1.319	7.887	0.159	16.64	0.428	11.36	0.171
Minimum	0.458	0.001	0.000	19.81	0.329	27.71	0.002
Maximum	6.000	34.95	0.858	79.57	2.038	79.19	0.901

Correlation results							
lnEF	1						
NR	-0.131	1					
lnFD	0.445	-0.276	1				
UB	0.047	-0.414	0.009	1			
lnBI	0.324	-0.014	0.164	0.569	1		
lnGB	0.577	-0.284	0.002	0.518	0.230	1	
lnHD	0.121	-0.240	0.167	0.265	0.229	0.592	1

Table 4 Cross-sectional dependence results

Variables	Breusch–Pagan LM	Pesaran scaled LM	Pesaran CD
EF (log)	561.9135 ^a	48.3323 ^a	18.38443 ^a
NR	498.8934 ^a	69.5623 ^a	22.67538 ^a
FD (log)	420.9936 ^a	34.8962 ^a	17.89292 ^a
UB	1583.678 ^a	105.6483 ^a	24.74673 ^a
BI (log)	806.5597 ^a	71.44687 ^a	7.648187 ^a
GB (log)	1318.610 ^a	120.4805 ^a	36.29245 ^a
HD (log)	1400.348 ^a	128.2739 ^a	37.38887 ^a

^a Implies statistical significance at 1% level

Table 5 Unit root results

Variables	Level		First difference	
	CIPS	CADF	CIPS	CADF
EF (log)	-2.564	11.23	-5.186 ^a	17.67 ^b
NR	-1.876	13.56	-4.654 ^a	22.43 ^a
FD (log)	-1.342	12.67	-3.287 ^a	16.34 ^a
UB	-1.345	10.32	-2.768 ^a	15.56 ^b
BI (log)	-1.416	15.89	-5.199 ^a	18.32 ^a
GB (log)	-2.561	10.45	-3.167 ^b	15.45 ^b
HD (log)	-1.632	16.98	-4.867 ^a	19.42 ^b

^{a,b} Imply statistical significance at the 1% and 5% levels, respectively

PCSE, and DK estimators, respectively. Also, biocapacity increases the EF by 0.15%, 0.34%, and 0.43% in the AMG, PCSE, and DK estimators, respectively. The key variable in Model 2 is the EF which shows a positive relationship with human well-being. In the same model (Model 2), natural resources, financial development, globalization, and biocapacity exact a positive impact on human well-being and are consistent across all estimators. This

Table 6 Westerlund cointegration results

Statistic	Value	Z value	Robust P value
<i>Model 1</i>			
G_t	-4.956 ^a	-4.459	0.000
G_a	-1.878	2.576	0.431
P_t	-12.98 ^a	-7.437	0.000
P_a	-3.867	2.921	0.410
<i>Model 2</i>			
G_t	-3.945 ^b	-2.887	0.021
G_a	-5.878	3.597	0.860
P_t	-10.659 ^c	-2.422	0.044
P_a	-3.861	1.874	0.712

^{a,b,c} Significance at 1%, 5% and 10% levels, respectively

confirms that the aforementioned variables promote human well-being in N11 countries.

The country-wise AMG results are shown in Tables 8 and 9. In Table 8, natural resources abate environmental degradation in Vietnam, Pakistan, Mexico, Iran, Egypt, and the Philippines, but not in Bangladesh, S/Korea, Nigeria, Indonesia, and Turkey. In Nigeria, for instance, crude oil exploration, the country’s major natural resource, has caused so much environmental havoc, especially in the Niger Delta. The situation is not even better in Indonesia where coal consumption is increasing the country’s footprint [37]. Financial development contributes to environmental quality in Nigeria, Mexico, and the Philippines. Urbanization and globalization have shown mixed results. The only consistent results in Table 8 relate to the effect of biocapacity on the EF. As earlier noted, all the N11 countries are harboring an ecological deficit territory as a result of their dwindling biocapacity.

Table 7 AMG, PCSE, and Driscoll/Kraay results

Variables	AMG	PCSE (AR(1))	Driscoll/Kraay
<i>Model 1</i>			
NR	- 0.023 (- 5.97) ^a	- 0.239 (- 4.13) ^a	- 0.412 (- 4.84) ^a
FD (log)	0.021 (4.21) ^a	0.013 (5.65) ^a	0.371 (2.30) ^b
UB	0.142 (3.36) ^a	0.210 (3.32) ^a	0.034 (6.17) ^a
GB (log)	- 0.049 (- 1.02)	- 0.087 (- 1.81) ^c	- 0.085 (- 1.50)
BI (log)	0.154 (2.34) ^b	0.345 (5.06) ^a	0.434 (4.06) ^a
HD (log)	0.056 (2.67) ^b	1.176 (4.08) ^a	1.567 (9.67) ^a
_cons	- 3.23 (- 7.63) ^a	- 0.267 (1.32)	- 1.218 (0.68)
<i>Model 2</i>			
NR	0.234 (1.34)	0.871 (1.27)	0.671 (6.67) ^a
FD (log)	0.218 (4.78) ^a	0.310 (3.34) ^a	0.982 (6.34) ^a
UB	- 0.453 (5.06) ^a	- 0.342 (4.09) ^a	- 0.564 (1.24)
GB (log)	0.054 (6.18) ^a	0.102 (4.45) ^a	0.005 (4.51) ^a
BI (log)	- 0.034 (- 1.04)	- 0.546 (- 5.19) ^a	- 0.654 (- 2.63) ^b
EF (log)	0.329 (2.49) ^b	0.338 (6.96) ^a	0.432 (7.32) ^a
_cons	0.678 (4.86) ^a	- 1.463 (- 8.27) ^a	- 1.215 (- 6.69) ^a
Number of regressors	6	6	6
Number of observations	280	280	280
Number of groups	11	11	11
R-squared (model 1)	-	0.8896	0.8711
R-squared (model 2)	-	0.9302	0.8742
Wald chi ² (model 1)	31.21	-	-
Wald chi ² (model 2)	42.15	-	-

^{a,b,c} Significance at 1%, 5%, and 10% levels, respectively. () are the t-stat

Table 8 Model 1 with lnEF as the dependent variable

	Bangladesh lnEF	Egypt lnEF	Indonesia lnEF	Iran lnEF	S/Korea lnEF	Mexico lnEF	Nigeria lnEF	Pakistan lnEF	Philippines lnEF	Turkey lnEF
NR	0.04 (1.38)	- 0.01 (- 0.14)	0.12 ^a (6.16)	- 0.00 (- 0.10)	0.02 (1.07)	- 0.08 ^a (- 7.91)	0.02 ^a (2.82)	- 0.08 ^a (- 5.45)	- 0.07 ^b (- 2.28)	0.02 (0.64)
lnFD	0.02 (0.32)	0.04 ^a (8.51)	0.04 ^a (4.60)	0.11 (0.82)	0.74 ^a (4.44)	- 0.22 ^b (- 2.38)	- 0.33 ^a (- 14.1)	0.06 ^a (3.24)	- 0.04 (- 0.46)	0.06 ^a (5.60)
UB	2.37 ^a (2.88)	- 0.18 (- 0.06)	- 0.61 (- 0.84)	5.64 ^a (4.83)	26.9 ^a (4.43)	9.93 ^a (4.24)	5.90 ^b (2.58)	- 2.48 (- 0.84)	1.13 (0.46)	- 4.81 (- 0.61)
lnGB	- 0.59 ^b (- 2.31)	0.08 ^a (7.15)	0.34 ^b (2.43)	- 0.02 (- 0.14)	- 1.48 ^a (- 4.06)	- 0.50 (- 0.35)	- 0.41 ^c (- 1.83)	0.13 (0.50)	0.09 ^a (6.89)	- 0.44 ^a (- 6.12)
lnBI	0.66 ^b (2.38)	0.10 ^a (3.70)	0.30 ^a (9.18)	0.33 ^a (3.53)	0.54 (1.22)	0.24 ^a (8.30)	0.37 ^a (8.39)	0.57 ^a (5.43)	0.52 (0.75)	0.94 ^c (1.80)
lnHD	1.39 (1.11)	- 0.99 (- 0.39)	0.17 (0.13)	0.77 (1.25)	8.31 ^a (5.20)	3.15 ^a (19.2)	2.22 ^a (9.05)	0.49 (0.79)	2.24 (0.67)	0.36 (0.17)
_cons	- 3.81 ^b (- 2.19)	0.11 (0.01)	1.30 (0.48)	- 21.5 ^a (- 4.85)	- 99.2 ^a (- 4.10)	- 38.0 (- 0.42)	- 16.2 ^b (- 2.32)	8.78 (0.97)	- 3.59 (- 0.32)	21.6 (0.68)

Source: t statistics in parentheses; ^a $p < 0.10$, ^b $p < 0.05$, ^a $p < 0.001$

Further findings in Table 8 reveals that human well-being increases the EF in all the countries except in Egypt. This further emphasized the trade-off between

both variables. EF is the key variable of concern in Table 9. From the results obtained, EF exacts a negative and insignificant impact on human well-being only in

Table 9 Model 2 with lnHD as the dependent variable

	Bangladesh lnHD	Egypt lnHD	Indonesia lnHD	Iran lnHD	S/Korea lnHD	Mexico lnHD	Nigeria lnHD	Pakistan lnHD	Philippines lnHD	Turkey lnHD	Vietnam lnHD
NR	− 0.00 (− 1.40)	0.00 ^c (1.91)	− 0.00 ^a (− 2.60)	− 0.00 (− 0.03)	− 0.00 ^a (− 5.03)	− 0.00 (− 0.51)	0.00 (0.10)	− 0.00 (− 1.20)	− 0.00 (− 0.51)	0.00 (1.42)	0.00 (0.56)
lnFD	0.00 (0.27)	0.01 ^a (3.21)	0.02 ^b (2.58)	− 0.13 ^a (− 3.27)	0.05 ^a (5.07)	− 0.01 ^c (− 1.91)	0.09 ^c (1.79)	0.00 (0.60)	0.00 (0.46)	− 0.01 (− 0.95)	0.07 ^b (1.99)
UB	− 0.28 ^b (− 2.04)	0.02 (0.10)	0.09 (1.00)	− 1.83 ^a (− 2.86)	− 1.02 ^a (− 3.64)	− 0.73 (− 0.65)	− 3.31 ^a (− 4.64)	− 4.12 ^a (− 5.34)	0.60 ^a (4.75)	− 3.49 ^a (− 3.93)	− 1.27 ^c (− 1.93)
lnGB	0.02 ^a (3.56)	0.01 ^a (5.39)	0.00 (0.12)	− 0.02 (− 0.42)	0.09 ^b (5.54)	0.08 ^b (2.09)	− 0.02 (− 0.07)	0.20 ^b (2.13)	0.03 ^a (7.45)	0.00 ^b (2.07)	0.03 ^a (6.85)
lnBI	− 0.04 (− 0.68)	− 0.01 (− 0.80)	− 0.13 ^a (− 7.43)	− 0.06 ^b (− 2.04)	− 0.04 ^c (− 1.90)	0.06 ^a (7.99)	− 0.11 ^a (− 3.22)	− 0.00 ^a (− 9.87)	0.01 ^a (4.67)	− 0.10 ^a (− 4.81)	− 0.14 ^a (− 8.43)
lnEF	0.05 (1.13)	− 0.00 (− 0.01)	0.00 (0.08)	0.15 ^b (2.30)	0.04 ^a (5.71)	0.00 (0.60)	0.21 (0.95)	0.08 (1.19)	0.03 ^b (2.01)	0.00 ^a (8.76)	0.34 ^a (7.45)
_cons	− 0.15 (− 0.42)	− 0.73 (− 0.67)	− 0.88 ^a (− 2.64)	6.71 ^a (2.68)	3.34 ^a (2.82)	2.32 (0.51)	10.3 (0.67)	12.4 ^a (5.09)	− 2.74 ^a (− 4.88)	13.5 ^a (3.77)	0.19 ^a (4.19)

t statistics in parentheses; =^a $p < 0.10$, ^b $p < 0.05$, ^a $p < 0.001$ "

Egypt. The positive impact of EF on human well-being in the remaining countries infers trade-offs. Meaning that the attainment of human well-being objectives is achieved at the expense of environmental degradation in these countries.

Discussion

The negative relationship between natural resources rent and EF suggests that the exploration of natural resource ensures environmental sustainability. The finding corroborates the results of Danish et al. [18] for BRICS, Zhang et al. [88] for Pakistan, Erdoğan et al. [22] for sub-Saharan Africa, Zafar et al. [85] for the USA, Kongbua- mai et al. [36] for ASEAN countries, and Pata et al. [58] for countries with the largest EF. However, it contradicts the findings of Nathaniel [46] and Wang et al. [78] who reported the adverse effect of natural resources rent on the EF in ASEAN and G7 countries, respectively. The discrepancies in the findings could have been informed by the choice of variables and estimation techniques. For instance, Nathaniel [46] controlled for human capital and economic growth, while the current study did not consider both variables.

The findings revealed that globalization has no adverse effects on the environment. Globalization may not be harmful especially when it is properly managed through the enactment of strict regulation to curtail the importation of harmful products and “dirty” technology. This finding is in line with those of Saud et al. [66] for OBOR, Ahmed et al. [5] for Japan, Pata [58] for the USA, and Pandey et al. [57] for Asia, but contradicts the findings of Ahmed et al. [6] for the USA, Yang et al. [82, 83] for Gulf

Cooperation Council countries, Pata and Caglar [59] for China, and Kirikkaleli et al. [34] for Turkey. Urbanization increases economic activities which drive energy consumption. Since the energy source in N11 countries is mainly non-renewable (e.g., fossil fuels) it is possible for an increase in energy demand to create ecological pressure, hence increasing the EF. The increased urbanization rate in N11 countries could be attributed to economic expansion which results in low energy efficiency, waste generation, and increased energy demand. Urbanization accelerates human demand on the Earth’s resources which reduce the biocapacity and increase the EF [56]. The findings in this study complement those of Ahmed et al. [4], Erdoğan et al. [22], Hassan et al. [27], Nathaniel et al. [48, 52, 53], Ulucak and Bilgili [74]. On the flip side, Danish et al. [18] and Nathaniel et al. [50] discovered no harmful impact of urbanization on EF in BRICS.

The positive impact of financial development on the EF confirms the lingering argument that financial development promotes economic growth which triggers human demand on ecological resources; hence an increase in the EF. This is in line with the findings of Usman et al. [77], Ahmed et al. [5], Yang et al. [83], Khalid et al. [32], Yang et al. [82], Sharma et al. [69], Yasin et al. [84], Saud et al. [66], Baloch et al. [10].

Interestingly, human well-being adds to the EF across the three specifications (AMG, DK, and PCSE). The intuition here is that the efforts/policies that are channeled toward promoting human well-being are not in consonance with environmental wellness, meaning that policies directed toward human well-being are causing environmental degradation. Simply put, a trade-off

Table 10 CS-ARDL results

Variables	Model 1	Model 2
<i>Long-run results</i>		
NR	- 0.56 (- 4.52) ^a	0.23 (3.81) ^a
FD (log)	0.04 (5.67) ^a	0.45 (8.54) ^a
UB	0.78 (3.24) ^a	- 0.08 (- 6.87) ^a
GB (log)	- 0.01 (- 2.02) ^b	0.76 (5.34) ^a
BI (log)	0.34 (4.76) ^a	- 0.37 (- 2.12) ^b
HD (log)	1.06 (3.05) ^a	-
EF (log)	-	0.16 (5.25) ^a
<i>Short-run results</i>		
NR	0.18 (3.67) ^a	- 0.65 (3.24) ^a
FD (log)	0.06 (1.43)	0.21 (1.03)
UB	1.23 (1.18)	- 0.39 (- 2.22) ^b
GB (log)	- 0.25 (- 2.24) ^b	0.04 (3.39) ^a
BI (log)	1.67 (3.87) ^a	- 0.34 (- 1.57)
HD (log)	0.13 (7.23) ^a	-
EF (log)	-	- 1.52 (- 7.25) ^a
ECT(- 1)	- 0.73 (- 4.56) ^a	- 0.84 (- 6.73) ^a

^a^b Significance at 1% and 5% levels, respectively. () are the *t*-stat

exists between EF and human well-being. Environmental quality and human well-being are two different sides of the same coin but have been considered in isolation in the N11 countries. The consideration of environmental objectives in policies designed to improve human well-being will aid the attainment of sustainability and inhibit environmental degradation. These findings are complemented in the CS-ARDL long-run results in Table 10. Besides, the short-run results in Table 10 affirmed the deteriorating impact of all the variables, except globalization, on the EF in the N11 countries.

In Model 2, EF increases human well-being. This outcome is appealing. It suggests that environmental sustainability policies amount to a welfare loss. That is, efforts to promote environmental sustainability declines human well-being. Environmental preservation policies are not compatible with human well-being in N11 countries. Natural resources have been a major source of foreign exchange earnings in the N11 countries, especially in Nigeria, Mexico, Iran, Egypt, and Indonesia. Natural resources can have an effect on human well-being directly or indirectly [38]. These resources yield income which could improve the well-being of the citizenry. However, the N11 countries still need to inculcate sustainable natural resource exploration practices so resources can regenerate to curb biocapacity depletion. Financial development leaves people with income that they can use to sustain their existence. Depending on the initial level of income,

financial development could contribute to human well-being [33]. More so, financial development enhances technological innovation and human capital development by pooling out idle funds which are invested in socially beneficial areas [62]. Globalization opens up the economy and allows for the importation of technology and products which could improve human well-being [70].

MEA (2005) noted that the efforts made in relation to ecosystem improvement have actually improved human well-being but at a cost to the environment. The MEA further highlighted that the link between human well-being and the functioning of the ecosystem is a complex one that rests solely on human actions which could be positive or negative. The findings of this study have shown that (SDGs 15) and (SDGs 3) cannot be simultaneously achieved in the N11 countries. As noted by Bowen et al. (2017), it is vital for some SDGs to be prioritized in some regions of the world. Whether environmental quality should be sacrificed for well-being or economic growth has remained an unending debate in the literature. To ease the pathways to SDGs attainment, policymakers in the N11 countries must identify and deal with trade-offs that could frustrate the effective achievement of the SDGs by 2030 [71].

Table 11 presents different directions of causality. A feedback causality exists between globalization, financial development, human well-being, and EF. This suggests a strong link between the aforementioned variables and EF, especially between human well-being and EF which could inform necessary policy directions. A unidirectional causality flows from urbanization and biocapacity to EF, and from human well-being to biocapacity, urbanization, financial development, and globalization. However, no direction of causality exists between natural resources and EF, biocapacity and natural resources, globalization and natural resources, and between human well-being and natural resources.

Conclusions

This study examined the nexus between human well-being and EF in the N11 countries from 1990 to 2016. We started by checking for CD in the dataset. The existence of CD informed the use of econometric techniques (including unit root, cointegration, parameter estimation, and causality test) that are consistent with the nature of data. The findings revealed a trade-off between EF and human well-being. Natural resources and globalization decline the EF, while financial development and biocapacity add to the EF. The outcome of this study necessitated relevant policy directions.

Table 11 D–H causality test

Null hypothesis	W-stat	Zbar-stat	Probability	Decision
NR → InEF	1.589	− 0.845	0.397	No causality
InEF → NR	2.982	1.009	0.312	
InFD → InEF	4.850	3.496	0.000	Bidirectional causality
InEF → InFD	4.351	2.831	0.004	
InGB → InEF	4.143	2.564	0.010	Bidirectional causality
InEF → InGB	4.047	2.437	0.014	
UB → InEF	4.582	3.151	0.001	Unidirectional causality
InEF → UB	2.599	0.503	0.614	
InBI → InEF	3.283	1.416	0.156	Unidirectional causality
InEF → InBI	4.328	2.811	0.004	
InHD → InEF	3.775	1.846	0.064	Bidirectional causality
InEF → InEF	6.753	3.264	0.001	
InFD → NR	4.208	2.632	0.008	Unidirectional causality
NR → InFD	1.760	− 0.619	0.535	
InGB → NR	2.673	0.597	0.549	No causality
NR → InGB	1.346	− 1.169	0.242	
UB → NR	4.754	3.368	0.000	Bidirectional causality
NR → UB	4.366	2.852	0.004	
InBI → NR	2.817	0.789	0.430	No causality
NR → InBI	2.717	0.656	0.511	
InHD → NR	2.925	0.795	0.426	No causality
NR → InHD	1.918	− 0.440	0.659	
InGB → InFD	5.970	4.987	0.006	Unidirectional causality
InFD → InGB	2.629	0.590	0.590	
UB → InFD	6.711	5.975	0.002	Bidirectional causality
InFD → UB	5.198	3.959	0.008	
InBI → InFD	3.382	1.541	0.123	Unidirectional causality
InFD → InBI	5.711	4.643	0.061	
InHD → InFD	4.716	2.993	0.002	Unidirectional causality
InFD → InHD	1.948	− 0.403	0.686	
InBI → InGB	4.444	2.965	0.003	Bidirectional causality
InGB → InBI	3.903	2.244	0.024	
InHD → InGB	4.815	3.124	0.001	Unidirectional causality
InGB → InHD	2.042	− 0.285	0.775	
InBI → UB	2.423	0.268	0.788	Unidirectional causality
UB → InBI	4.959	3.654	0.000	
InHD → UB	5.380	3.819	0.000	Unidirectional causality
UB → InHD	3.249	1.198	0.230	
InHD → InBI	5.173	3.565	0.000	Unidirectional causality
InBI → InHD	2.604	0.404	0.685	

→ represents “does not homogeneously cause”

Since there is a trade-off between EF and human well-being, it is recommended that policymakers come up with policy proposals that integrate the promotion of human well-being and environmental preservation. A strong and viable institutional framework can help mitigate the trade-off and uphold the simultaneous attainment of human well-being and environmental sustainability goals. From our findings, globalization can ensure environmental sustainability. Globalization emanates from policies in different domains including transport, trade (import and export), finance, migration, politics, etc. The N11 countries should be more financially integrated into the world economy. The governments of the N11 countries should support financial and trade liberalization, that is, the political structure should encourage more inflows of foreign capitals and technologies. However, these foreign funds and technologies are to be invested/used in green production processes. The various dimensions of globalization should be taken into consideration when enacting environmental sustainability policies.

In countries like Bangladesh, S/Korea, Nigeria, Indonesia, and Turkey where natural resources decline environmental quality, there is a need to imbibe sustainable practices into the countries resource exploration. The increasing impact of financial development on the EF shows the weakness in countries financial institutions to direct financial investments in less-polluting ventures. The financial system needs to be strengthened to encourage investment in less-polluting sectors and clean technologies. The negative influence of urbanization on human well-being calls for the adequate provision of infrastructures and basic amenities in the rural areas which will not only curtail the upward surge in urbanization and its anomaly but also promote economic and environmental sustainability. Finally, since urbanization is found to be associated with environmental degradation via increasing the EF, the N11 countries should redesign their urbanization policies to make urbanization more sustainable. As such, the government should facilitate the sustainable transformation of the production and consumption practices within the urban areas. Urban sustainability could be achieved through the promotion of green housing projects and green transportation in urban areas. Developing environmentally friendly technologies is also imperative for minimizing the adverse environmental impacts of urbanization in the N11 countries.

This study considered just eleven countries. Also, the time period was limited to just 27 years and some determinants of human well-being were not considered all due to data constraint, hence the limitations of the study. Besides, although an improvement over just using income to measure well-being, the HDI has a number of internal inconsistencies that make it problematic to

use to determine whether the well-being of a country's citizens has really improved or not. For instance, the index (HDI) does not include any ecological considerations, rather focuses almost exclusively on national performance and ranking, without much attention to development from a global perspective [63]. Now, the future study may want to explore the interactive effect of

institutional quality and inequality on both sustainability indicators within the vicinity of a more robust estimation technique(s) by extending the sample to include more developing countries for a more meaningful study.

Appendix

See Figs. 6, 7, and 8.

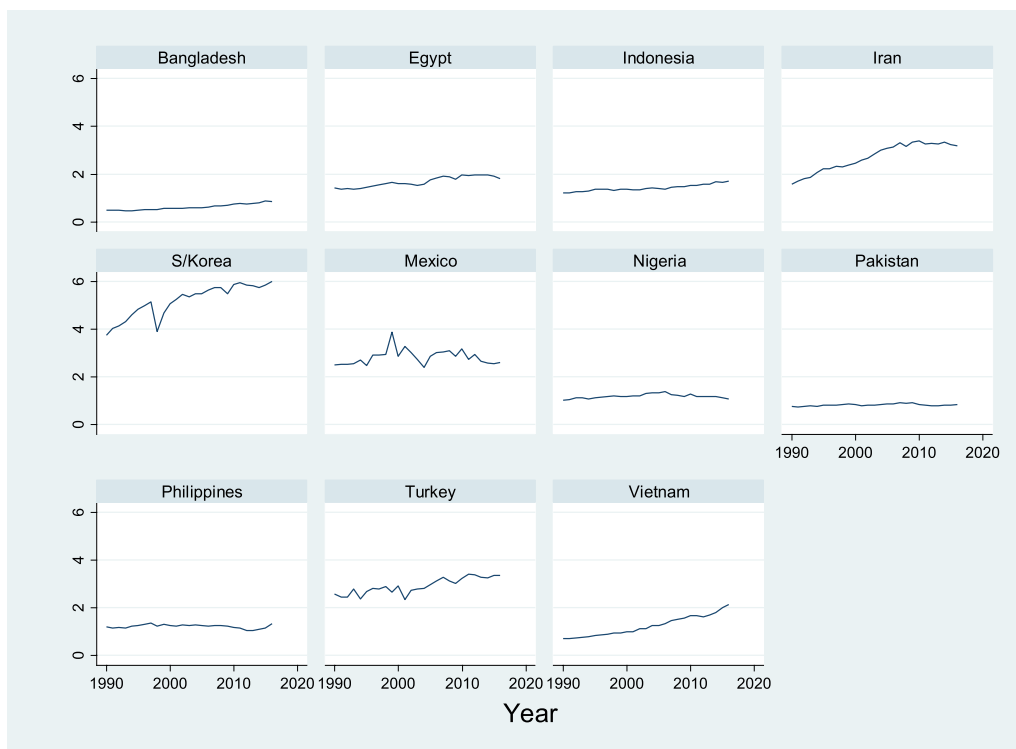


Fig. 6 EF in the individual N11 countries

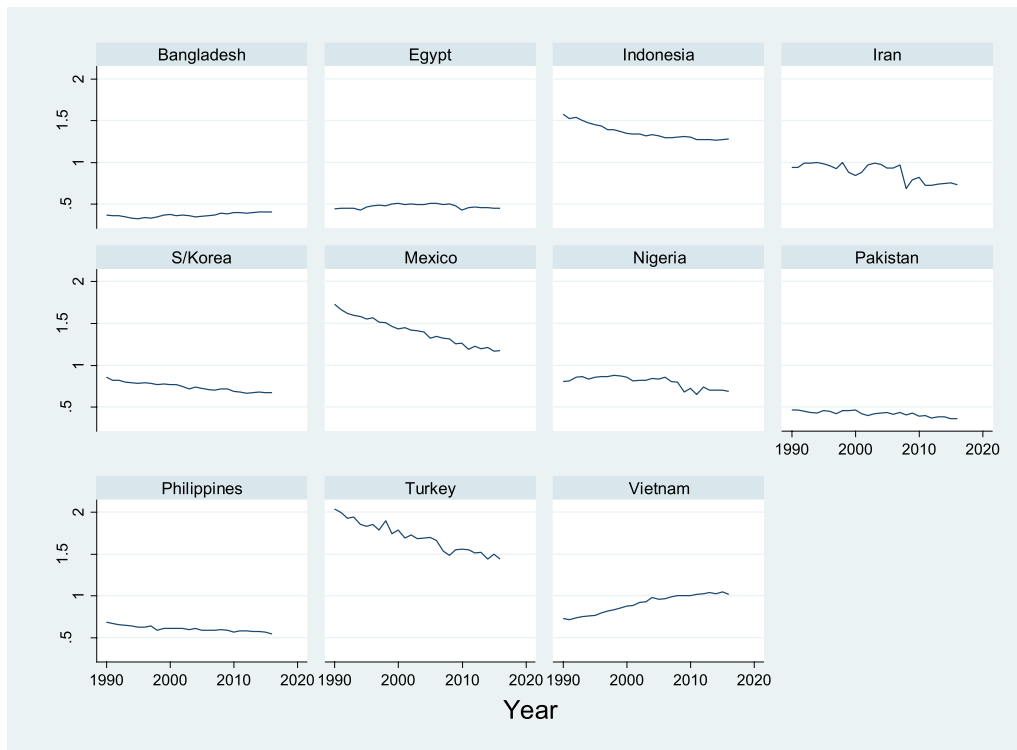


Fig. 7 Biocapacity in the individual N11 countries

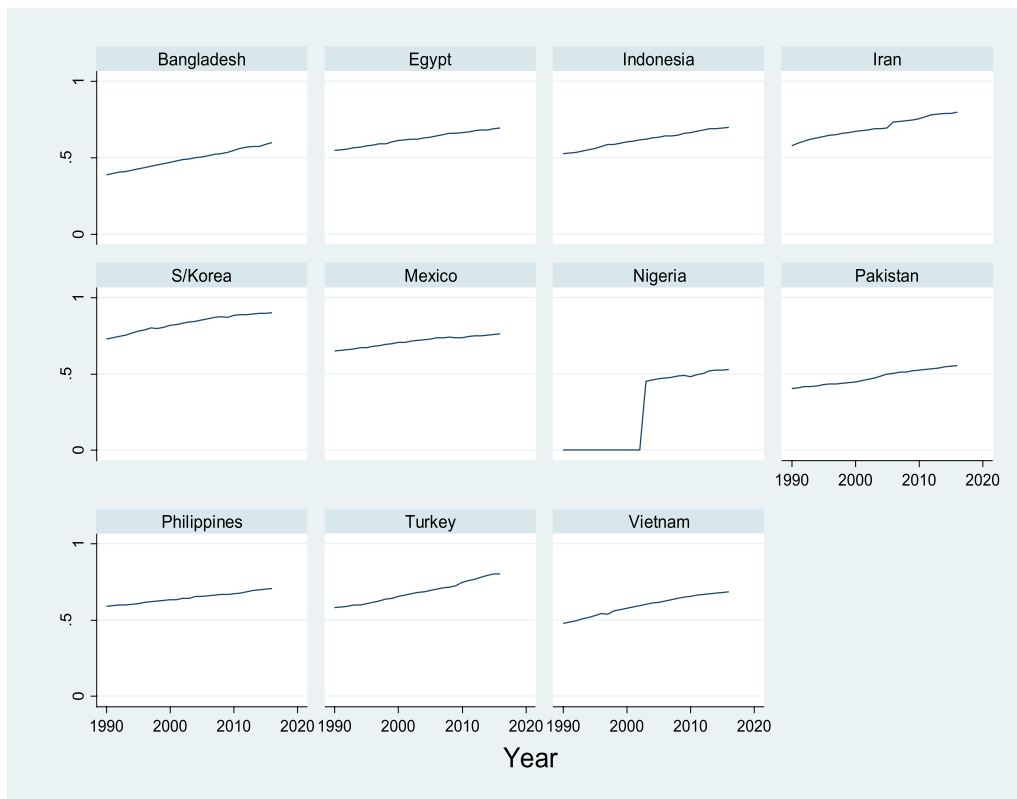


Fig. 8 HDI in the individual N11 countries

Abbreviations

N11: Eleven fastest emerging economies; CD: Cross-sectional dependence; EF: Ecological footprint; AMG: Augmented mean group; MEA: Millennium Ecosystem Assessment; SDGs: Sustainable development goals; DH: Dumitrescu and Hurlin; OBOR: One-belt-one-road; FGLS: Feasible generalized least squares; DK: Driscoll and Kraay; PCSE: Panel-corrected standard errors; HDI: Human development index; PMG: Pooled mean group; CIPS: Cross-sectionally augmented IPS; CS-ARDL: Cross-sectionally augmented autoregressive distributed lag; CADF: Cross-sectionally augmented ADF.

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Authors' contributions

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Availability of data and materials

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Declaration

Competing interests

The author declares no competing interest.

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