Inclusive Green Growth Dataset for African Countries

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24 June 2024

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Abstract

Tracking the progress of countries in inclusive green growth (IGG) is crucial for shaping effective sustainable development policies. However, comprehensive IGG data is often inaccessible. Accordingly, rigorous empirical contributions in this direction in the context of Africa remain sparse. To address this, we computed IGG scores for 22 African countries from 2000-2020. Our data reveal that only nine of these countries are achieving green and inclusive growth. This dataset equips researchers and institutions to assess IGG progress and identify pathways for African governments to promote sustainable development.

Keywords: Africa, Inclusive green growth, IGG Index, Sustainable Development

JEL Codes: O55; Q01

1. Introduction

Tracking the progress of countries in inclusive green growth (IGG) is critical to sustainable development. Nonetheless, IGG data spanning at least two decades are not readily accessible in databases. Accordingly, rigorous empirical contributions in this direction in the context of Africa are hard to find in sustainable development scholarship. We address this gap by computing comprehensive IGG data for 22 selected African countries from 2000-2020.[1] The choice of the sampled countries and periodicity is due to data availability. For instance, data on the mortalities from exposure to ozone and wealth changes are markedly scanty or missing for countries such as Somalia, Eritrea, Chad, Eswatini, Niger, Libya, and Zambia.

2. Computation of IGG index

This write-up details how the inclusive green growth (IGG) index in Ofori, Asongu, and Freytag (2024) was generated. The IGG index is obtained by considering the relevant variables for environmental and socioeconomic sustainability. This means that IGG goes beyond green growth, which is economic growth adjusted from environmental degradation (OECD, 2017) to include issues of social equity. First, regarding the socioeconomic sustainability dimension of IGG, we considered variables that matter for social inclusion and protection (see e.g., Ofori et al., 2022; Ofori et al., 2023a, 2023b; Ofori & Figari, 2023). We sourced variables such as income growth, income inequality, infant mortality, unemployment, undernourishment, healthcare expenditure, and access to potable water and sanitation to capture socioeconomic sustainability.

Concerning the environmental sustainability aspect of IGG, we paid attention to the environmental quality of life, environmental and resource productivity, natural capital, and economic opportunities and policy response for environmental progress. In accordance with the sustainable development literature, we included environmentally related variables such as air pollution, black carbon, carbon intensity, temperature changes, forest area, fish

[1] Algeria, Angola, Benin, Botswana, Cameroon, Democratic Republic of Congo, Congo Republic, Cote d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Senegal, South Africa, Tanzania, Togo, Tunisia.

production, methane emissions, and global value chain participation in our IGG computation. (see, e.g., Acosta et al., 2020; OECD, 2017; Fay, 2012).

Overall, 22 variables, which are explained in Table 1, were used in our computations, and the summary statistics are reported in Table 2. Considering the dimensionality of these variables, we employed a dimensional reduction technique for calculating our IGG, which was principal component analysis (PCA). PCA is a powerful technique that keeps the dimensionality of several correlated variables while addressing the problem of collinearity to obtain a smaller set of indices known as principal components (Jolliffe, 2002). In line with the standard procedure for PCA, we first tested the adequacy of our 23 variables as a sample for IGG by using the Kaiser-Meyer-Olkin (KMO) test of sample adequacy. Second, we ascertained the correlation between the 23 variables and the overall sample by using the pairwise correlation and Bartlett tests.

The attendant findings justified the application of PCA to compute the IGG series. To begin, we found evidence that the 23 variables formed an adequate sample for IGG, considering the KMO value of 0.771. Second, we showed that the correlation between the 23 variables was strong enough for PCA (see Table 3). This was reinforced by the Bartlett statistics of 12428.4, which is statistically significant at 1%. With the requirements met, we proceeded to generate our IGG series. The IGG index was calculated based on the first five components since their attendant eigenvalues satisfied the Kaiser rule of at least 1. The resultant eigenvalues and eigenvectors for our IGG index are reported in Table 4 and Table 5, respectively, whilst the scree plot for the principal components is displayed in Figure A.1.

3. Results: IGG scores

We contribute to the sustainable development discourse by presenting a unique index for tracking the progress of African countries in inclusive green growth. Our IGG index is constructed by taking into account variables that matter for a country's triple bottom line, viz., economy, society, and the environment. Of the twenty-two (22) sampled countries, the data shows that only nine (9) are growing green and inclusive. These countries are Togo, Mauritius, Nigeria, Benin, Ghana, Morocco, Senegal, Tunisia, and Tanzania (see Figure 1). The

progress of these countries is, to a large extent, a result of their strong commitment to income equality reduction, poverty alleviation, enhanced access to essential social resources, and renewable energy.

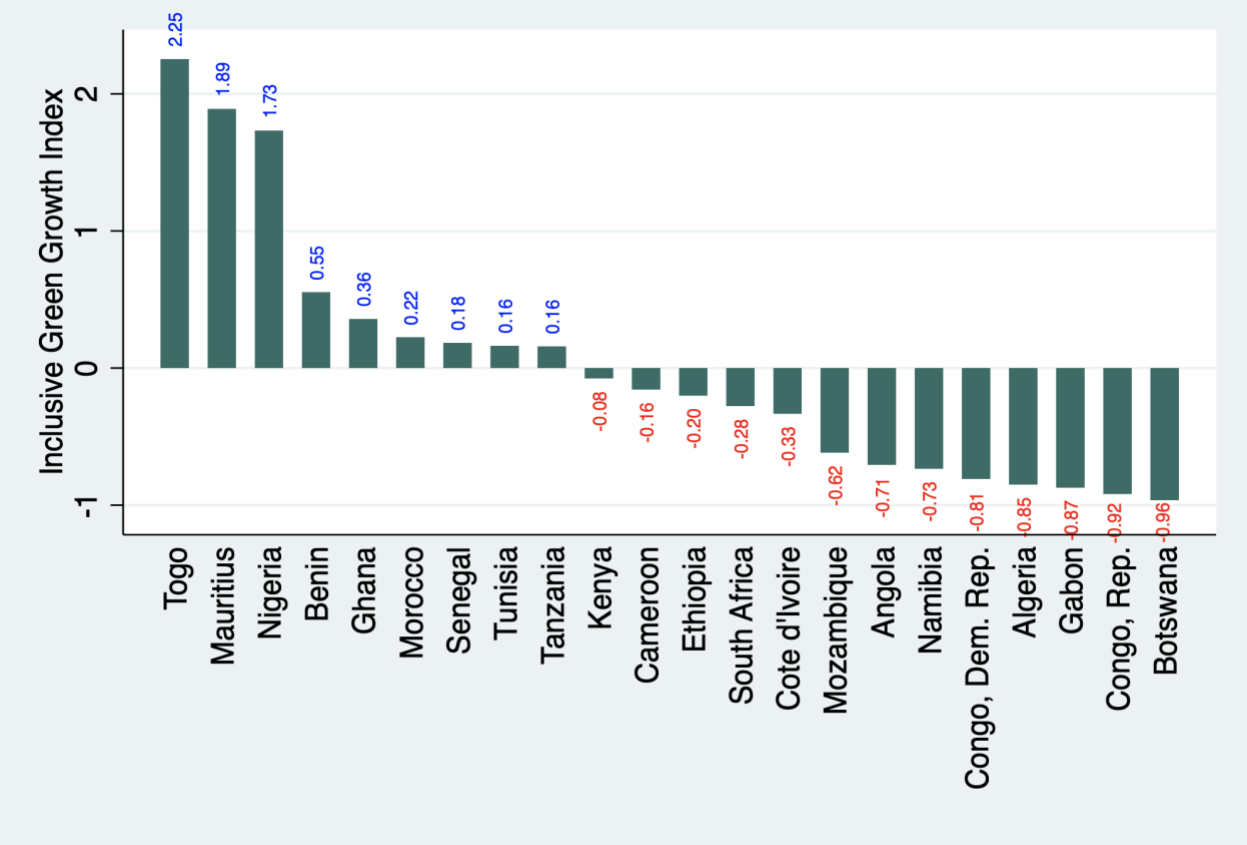

Figure 1: Inclusive green growth in African countries, 2008-2020.

4. Value of the data

The data enable researchers, institutions, and governments to track the progress of countries in inclusive green growth. The data is particularly relevant for African governments and their development partners who seek to channel resources into sectors that are key to resilient, greener, and more inclusive growth. Additionally, researchers, students and institutions can employ the data to identify pathways that African governments and their development organisations can adopt to promote sustainable development in Africa.

Data availability

Access/download: Inclusive Green Growth Dataset for African Countries

Ofori, I. K., Gbolonyo, E. Y., & Ojong, N. (2024). Inclusive Green Growth Dataset for African Countries [Dataset]. Zenodo. **https://doi.org/10.5281/zenodo.12529764**

Reference:

Acosta, L.A., Zabrocki, S., Eugenio, J.R., Sabado Jr. R., Gerrard S.P., Nazareth M., and Luchtenbelt, H.G.H. (2020). Green Growth Index 2020 – *Measuring performance in achieving SDG targets, GGGI Technical Report No. 16, Green Growth Performance Measurement Program,* Global Green Growth Institute (GGGI), Seoul, South Korea

Fay, M. (2012). *Inclusive green growth: The pathway to sustainable development*. World Bank Publications.

Jolliffe, I. T. (2002). Principal components in regression analysis. *Principal component Analysis*, 167-198.

Ofori, I. K., Freytag, A., & Asongu, S. A. (2024). Economic globalisation and Africa's quest for greener and more inclusive growth: The missing link. *International Economics, 178*, 100509.

Ofori, I. K., & Figari, F. (2023). Economic globalisation and inclusive green growth in Africa: Contingencies and policy-relevant thresholds of governance. *Sustainable Development*, *31*(1), 452-482.

Ofori, I. K., Figari, F., & Ojong, N. (2023a). Towards sustainability: The relationship between foreign direct investment, economic freedom and inclusive green growth. *Journal of Cleaner Production*, *406*, 137020.

Ofori, I. K., Gbolonyo, E. Y., & Ojong, N. (2023b). Foreign direct investment and inclusive green growth in Africa: Energy efficiency contingencies and thresholds. *Energy Economics*, 117, 106414.

Ofori, I. K., Gbolonyo, E. Y., & Ojong, N. (2022). Towards Inclusive Green Growth in Africa: Critical energy efficiency synergies and governance thresholds. *Journal of Cleaner Production*, 369, 132917.

OECD (2017). Green Growth Indicators 2017. OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264268586-en.

Table 1: Definition of Variables in Inclusive Green Growth (IGG) Index

Variable	Symbol	Variable description	Data source
A. Socioeconomic sustainability			
(i) Social context			
Sanitation	*sanit*	Population with access to improved sanitation, % total population	WDI
Fertility rate	*fertility*	Fertility rate, total (births per woman)	WDI
Healthcare spending	*health*	Current health expenditure (% of GDP)	WDI
Potable water	*water*	Population with access to improved drinking water sources, % total population	WDI
Infant mortality	*infantmort*	Mortality rate, infant (per 1,000 live births)	WDI
Life expectancy	*lifeexp*	Life expectancy at birth, total (years)	WDI
Undernourishment	*undernourish*	Prevalence of undernourishment (% of population)	WDI
(ii) Economic context			
Changes in wealth	*weathchg*	Changes in wealth per capita (US$)	GGKP
Income growth	*gpc*	GDP per capita, PPP (constant 2017 international $)	WDI
Income inequality	*gini*	Gini index (0=Lowest; 1=Highest)	WIID
Unemployment	*unemp*	Unemployment, total (% of total labour force)	WDI
B. Environmental sustainability			
(i) Natural capital			
Fish production	*fish*	Total fisheries production (metric tons)	WDI
Agricultural land	*araland*	Arable land (% of land area)	WDI
Forest area	*forest*	Forest area (% of land area)	WDI
Temperature changes	*temp*	Annual surface temperature, change from 1951-1980	WDI
(ii) Environmental quality of life			
Air pollution	*pm25fossil*	Mean population exposure to PM2.5	NGAIN
Ozone mortalities	*ozonemort*	Mortality from exposure to ozone	OECD Statistics
Nitrous emission	*n2ofossil*	Nitrous emissions from fossil sources	EDGAR
Black carbon emission	*bcfossil*	Black carbon emissions from fossil sources	EDGAR
CO_2 pollution	*Co2fossil*	Carbon emissions from fossil sources	EDGAR
(ii) Environmental & resource productivity			
Methane emission	*methane*	Methane emissions (kt of CO_2 equivalent)	WDI
Carbon intensity	*co2fossil*	CO_2 emissions (metric tons per capita)	WDI
(iv) Economic opportunities & policy response			
Global value chain	*gvc*	Gross value added at basic prices (GVA) (constant 2015 US$)	WDI

Note: WDI is World Development Indicators; GGKP is Green Growth Knowledge Platform; WIID is World Income Inequality Database; EDGAR is The Emissions Database for Global Atmospheric Research
OECD Statistics: Organization for Economic Co-operation and Development

Table 2: Summary statistics of IGG variables, 2000-2020

Variable	Obs	Mean	Std. Dev.	Min	Max
unemp	462	9.477	7.737	.69	33.29
fish	462	267544.51	298552.51	0	1500000
undernourish	462	18.677	12.904	0	67.5
infant mort	462	51.353	23.794	12.5	121.5
methane	462	23268.009	26771.302	0	127900
lifeexp	462	60.742	7.937	46.267	77.063
gvc	462	5.917e+10	9.232e+10	2.200e+09	5.000e+11
gpc	462	6292.701	4924.631	630.702	22869.801
forest	462	32.249	23.253	.663	91.978
fertility	462	4.33	1.368	1.36	6.751
health	462	4.615	1.87	0	10.716
co2pc	462	1.358	1.718	0	8.569
ara land	462	13.895	12.731	0	48.722
weathchg	462	-101.955	655.687	-3281.8	1867.6
sanit	462	40.831	26.781	2.755	97.435
water	462	67.618	19.425	18.085	99.867
temp	462	1.005	.423	-.562	2.291
gini	462	53.812	8.813	0	74.227
co2 fossil	462	37766.838	91300.642	0	485745
bc fossil	462	2.919	5.378	0	27.96
n2o fossil	462	20.362	26.294	0	121.829
pm25 fossil	462	22.527	71.762	0	511.896
ozone mort	462	6.168	4.643	0	24.738

Note: See the meaning of the symbols in Table 1.

Table 3: Correlation matrix for IGG variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
unemp	1																						
fish	0.138**	1																					
undernourish	-0.185***	-0.300***	1																				
infant_mort	-0.458***	-0.0616	0.505***	1																			
methane	-0.188***	0.329***	-0.0160	0.244***	1																		
lifeexp	0.205***	0.0421	-0.489***	-0.847***	-0.168***	1																	
gvc	0.165***	0.514***	-0.294***	0.0657	0.650***	-0.0652	1																
gpc	0.662***	0.00674	-0.384***	-0.605***	-0.181***	0.472***	0.150**	1															
forest	-0.0384	-0.149**	0.378***	0.364***	-0.177***	-0.343***	-0.254***	-0.114*	1														
fertility	-0.571***	-0.116*	0.572***	0.878***	0.250***	-0.752***	-0.0554	-0.747***	0.517***	1													
health	0.363***	0.308***	-0.165***	-0.323***	0.0116	0.0740	0.124**	0.270***	-0.478***	-0.405***	1												
co2pc	0.642***	0.200***	-0.422***	-0.437***	-0.0283	0.279***	0.357***	0.678***	-0.189***	-0.595***	0.422***	1											
ara_land	-0.359***	0.0864	-0.345***	-0.0352	0.136**	0.103*	0.168***	-0.0854	-0.258***	-0.0787	-0.145**	-0.122**	1										
weathchg	-0.00225	0.100*	-0.0654	-0.122**	-0.200***	0.0556	-0.0393	0.0422	-0.345***	-0.220***	0.301***	0.0148	0.102*	1									
sanit	0.456***	0.194***	-0.524***	-0.668***	-0.109*	0.708***	0.232***	0.742***	-0.387***	-0.806***	0.276***	0.564***	0.0219	0.242***	1								
water	0.605***	0.110*	-0.630***	-0.749***	-0.293***	0.641***	0.148**	0.795***	-0.339***	-0.839***	0.293***	0.584***	0.0642	0.172***	0.773***	1							
temp	-0.0544	0.138**	-0.305***	-0.373***	0.0801	0.549***	0.123**	0.0584	-0.239***	-0.267***	-0.0356	0.0187	0.131**	-0.0282	0.307***	0.260***	1						
gini	0.164***	-0.0454	0.381***	0.258***	-0.254***	-0.554***	-0.173***	-0.160***	0.239***	0.267***	0.249***	0.0921*	-0.289***	0.104*	-0.424***	-0.205***	-0.352***	1					
co2_fossil	0.429***	0.427***	-0.360***	-0.151**	0.336***	0.0375	0.625***	0.308***	-0.255***	-0.299***	0.401***	0.817***	-0.0119	0.0244	0.329***	0.299***	0.0517	0.151**	1				
bc_fossil	0.400***	0.444***	-0.406***	-0.240***	0.328***	0.176***	0.577***	0.303***	-0.323***	-0.367***	0.402***	0.795***	-0.0551	0.0490	0.401***	0.331***	0.131**	0.0323	0.966***	1			
n2o_fossil	-0.0794	0.361***	-0.0875	0.0888	0.886***	-0.131**	0.596***	-0.129**	-0.273***	0.0915*	0.172***	0.148**	0.133**	-0.185***	-0.0989*	-0.235***	0.0713	-0.0804	0.489***	0.460***	1		
pm25_fossil	0.387***	0.375***	-0.293***	-0.164***	0.190***	0.0284	0.454***	0.250***	-0.182***	-0.273***	0.396***	0.782***	-0.0446	0.0344	0.262***	0.260***	0.0298	0.264***	0.930***	0.901***	0.414***	1	
ozone_mort	0.367***	0.313***	-0.222***	-0.294***	0.0143	0.304***	0.168***	0.197***	-0.391***	-0.355***	0.479***	0.267***	-0.181***	0.218***	0.358***	0.353***	0.157***	-0.0575	0.227***	0.281***	-0.0237	0.156***	1

Note: Note: See the meaning of the symbols in Table 1; * p < 0.05, ** p < 0.01, *** p < 0.001

Table 4: Principal components and eigenvalues for IGG index

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	7.659	3.548	0.333	0.333
Comp2	4.110	1.351	0.179	0.512
Comp3	2.759	1.064	0.120	0.632
Comp4	1.695	0.473	0.074	0.705
Comp5	1.222	0.271	0.053	0.758
Comp6	0.951	0.043	0.041	0.800
Comp7	0.908	0.218	0.040	0.839
Comp8	0.690	0.110	0.030	0.869
Comp9	0.581	0.073	0.025	0.895
Comp10	0.508	0.131	0.022	0.917
Comp11	0.377	0.024	0.016	0.933
Comp12	0.353	0.044	0.015	0.948
Comp13	0.309	0.085	0.013	0.962
Comp14	0.223	0.045	0.010	0.972
Comp15	0.178	0.058	0.008	0.979
Comp16	0.120	0.004	0.005	0.984
Comp17	0.115	0.040	0.005	0.989
Comp18	0.075	0.025	0.003	0.993
Comp19	0.050	0.006	0.002	0.995
Comp20	0.044	0.008	0.002	0.997
Comp21	0.036	0.009	0.002	0.998
Comp22	0.027	0.017	0.001	1.000
Comp23	0.010	.	0.000	1.000

Table 5: Eigenvectors for IGG variables

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10	Comp11	Comp12	Comp13	Comp14	Comp15	Comp16	Comp17	Comp18
unemp	0.227	-0.033	0.320	-0.131	0.210	0.200	0.043	-0.113	0.091	0.268	0.118	-0.307	-0.231	-0.601	-0.002	0.207	-0.099	0.065
fish	0.133	0.225	-0.102	0.164	0.122	0.021	0.599	-0.286	0.403	-0.298	0.019	0.088	-0.285	0.046	0.220	-0.160	0.090	0.042
undernourish	-0.239	0.041	0.211	0.051	0.260	0.012	-0.212	0.317	0.258	0.092	0.552	0.322	-0.321	0.062	-0.069	-0.054	0.223	-0.034
infantmort	-0.266	0.236	0.053	0.015	-0.067	0.158	0.195	0.188	-0.279	0.117	-0.150	0.275	-0.046	-0.128	0.358	0.075	0.068	-0.018
methane	0.009	0.359	-0.298	-0.058	0.241	0.215	-0.199	0.066	0.114	0.025	0.042	-0.114	0.277	0.013	0.104	0.155	0.206	0.347
lifeexp	0.228	-0.262	-0.222	-0.073	0.138	-0.238	-0.061	0.061	0.050	-0.236	0.246	-0.074	0.013	0.194	-0.195	0.020	0.051	0.120
gvc	0.148	0.326	-0.172	-0.080	0.037	0.300	0.203	0.139	0.009	0.366	-0.083	0.003	-0.170	0.275	-0.573	-0.122	-0.231	-0.142
gpc	0.262	-0.149	0.134	-0.234	-0.002	0.347	-0.077	0.050	0.169	0.134	-0.022	0.263	0.242	0.118	0.299	-0.349	0.134	-0.030
forest	-0.184	-0.017	0.215	-0.428	0.048	-0.031	0.380	-0.007	0.244	-0.142	0.181	0.028	0.546	-0.092	-0.226	0.120	-0.065	-0.041
fertility	-0.311	0.199	0.011	-0.029	0.040	-0.045	0.167	0.085	-0.116	0.050	-0.061	0.085	0.188	0.023	-0.122	0.151	0.194	0.046
health	0.186	0.084	0.176	0.436	0.116	0.011	-0.225	-0.296	0.122	-0.069	-0.225	0.520	0.232	-0.201	-0.345	0.122	0.024	0.018
co2pc	0.293	0.106	0.221	-0.179	-0.125	-0.040	-0.063	0.072	-0.138	-0.053	0.064	0.151	0.107	-0.010	0.064	-0.437	-0.228	0.076
araland	0.011	0.004	-0.356	0.058	-0.584	0.102	0.028	-0.299	-0.001	0.226	0.535	0.190	0.069	-0.160	0.008	0.098	-0.037	0.080
weathchg	0.065	-0.071	0.044	0.540	-0.282	0.116	0.135	0.561	0.283	-0.028	0.005	-0.287	0.247	-0.163	-0.032	-0.115	0.025	-0.028
sanit	0.296	-0.153	-0.068	-0.043	0.030	0.166	0.076	0.307	0.052	-0.121	-0.021	0.282	-0.054	0.189	0.208	0.623	-0.375	0.030
water	0.297	-0.200	0.033	-0.066	-0.084	0.126	0.097	-0.084	-0.005	0.244	-0.129	-0.088	0.014	0.190	-0.039	0.194	0.682	-0.089
temp	0.112	-0.082	-0.308	-0.035	0.200	-0.592	0.137	0.160	0.180	0.527	-0.142	0.193	0.094	-0.206	0.134	-0.076	-0.045	-0.011
gini	-0.077	0.126	0.452	0.166	-0.139	-0.220	-0.031	-0.209	0.232	0.351	0.026	-0.173	0.067	0.502	0.166	0.152	-0.178	0.241
co2fossil	0.244	0.321	0.111	-0.081	-0.139	-0.139	0.010	0.111	-0.116	-0.012	0.065	0.011	-0.018	-0.056	-0.041	0.026	0.047	0.222
bcfossil	0.262	0.285	0.064	-0.057	-0.074	-0.206	0.007	0.173	-0.153	-0.164	0.028	-0.022	-0.070	-0.070	-0.055	0.009	0.176	0.421
n2ofossil	0.058	0.382	-0.220	-0.031	0.134	0.044	-0.358	-0.098	0.248	-0.041	0.031	-0.220	0.169	-0.001	0.230	0.012	-0.118	-0.333
pm25fossil	0.220	0.291	0.171	-0.070	-0.200	-0.293	-0.014	0.072	-0.046	-0.113	0.109	0.011	-0.024	-0.004	0.030	0.196	0.160	-0.633
ozonemort	0.174	-0.012	0.038	0.363	0.433	0.038	0.239	-0.087	-0.514	0.102	0.394	-0.085	0.283	0.117	0.116	-0.048	-0.051	-0.120

Variable	Comp19	Comp20	Comp21	Comp22	Comp23	Unexplained
unemp	0.077	0.230	-0.093	-0.025	0.038	0
fish	0.084	0.004	-0.063	-0.010	-0.026	0
undernourish	0.065	-0.138	0.059	0.064	0.014	0
infantmort	0.047	0.390	0.504	-0.102	0.044	0
methane	0.069	-0.102	-0.095	-0.544	-0.089	0
lifeexp	0.122	0.682	0.193	-0.070	-0.054	0
gvc	-0.079	0.075	0.061	-0.038	0.066	0
gpc	-0.390	0.254	-0.253	0.080	-0.034	0
forest	-0.074	-0.134	0.266	0.014	0.041	0
fertility	0.320	0.304	-0.615	0.330	0.042	0
health	0.006	0.084	0.094	-0.017	0.013	0
co2pc	0.661	-0.105	-0.005	-0.137	0.126	0
araland	0.006	0.026	-0.034	0.026	0.074	0
weathchg	0.047	0.046	0.011	0.002	-0.002	0
sanit	0.094	-0.127	-0.098	0.096	0.038	0
water	0.301	-0.180	0.228	0.132	0.056	0
temp	-0.008	-0.074	-0.007	-0.011	0.011	0
gini	-0.010	0.138	0.038	-0.078	0.052	0
co2fossil	-0.087	-0.058	0.091	0.292	-0.766	0
bcfossil	-0.332	-0.057	0.029	0.194	0.584	0
n2ofossil	0.120	0.060	0.214	0.491	0.137	0
pm25fossil	-0.128	0.087	-0.197	-0.382	0.013	0
ozonemort	-0.086	-0.091	-0.004	0.056	0.008	0

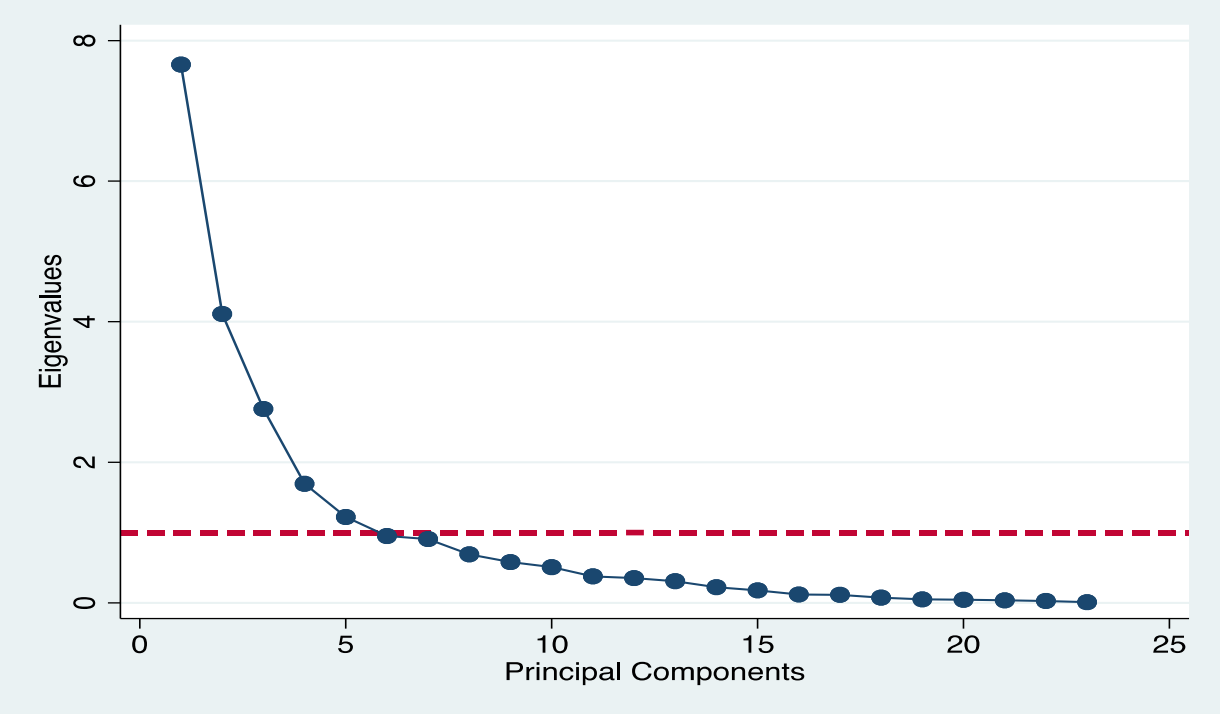

Figure A.1: Scree plot of principal components