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Do environmental factors matter in sustainable development goal index: A cross-sectional study Approach

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Abstract
The paper tries to examine the role of environmental factors like Unsafe Drinking Water (UWD), Tree Cover Loss (TCL), adjusted CO2 emissions (CDA), and Climate Change (CCH) in the Sustainability development index. It tries to inquire how well SDGI considers various critical environmental parameters that can potentially change the future of humankind. The study can be insightful for the policy formations, helping achieve environmental sustainability.

Keywords: Sustainable development, environment, humankind

1. Introduction
The concept development can be explained in various dimensions. However, the results of a nation's development efforts can be viewed from people's lives. According to the preamble of the declaration on the right to development denotes development "as a comprehensive economic, social, cultural and political process, which aims at the constant improvement of the well-being of the entire population and all the individuals on the basis for their active, free and meaningful participation in development and the fair distribution of benefits resulting therefrom."

The governments, from time to time, provide various policies to attain the ultimate goal of development. One such action is sustainable development. According to the World Commission on Environment and Development (WCED), "Sustainable development implies meeting the present's needs without compromising future generations' ability to meet their own needs." The Sustainable Development Goals is the need of the hour for any development agenda as it focuses on the challenges of the sustainable future of any humankind. It tries to improve people's quality of life through a better focus on educational attainment, fundamental freedom, health, environmental protection, and welfare. In short, sustainable development indicates development practices without depleting natural resources. They remind us of the needs and survival of future generations. In particular, the SDG index measures the holistic measure of development. Nowadays, almost all countries give special attention and care to sustainable development goals. There are many policies and practices to ensure sustainable development

This study is an attempt to understand how well SDGI takes into consideration various critical environmental parameters that have the potential to change the future of humankind. The study can be relevant to suggest an inclusive policy formation. There is an urgent need to consider public health and shift our focus on using a renewable energy source. Henceforth, this paper's main research hypothesis is to study the relationship of sustainable development goal index concerning environmental factors. Past literature in this area has used a wide range of factors. However, in this paper, we will broadly focus on climate change, unsafe drinking water, tree cover loss, and adjusted CO2 emission.

2. Literature review
The sustainable development report 2020 focuses on three dimensions for formulating its action plan: social, environmental, and economic factors. Throughout this paper, we are concerned about the environmental factors which affect sustainability goals. In line with these thoughts, Porecca (2020) investigates how environmental factors affect human capital. They found out that carbon emission and air pollution are the critical factors that affect human capital. Howarth and Norgaard (1992) [3] say that environmental valuation is a way to see how we care about future generations. This is what we call sustainable development. Too little caring about the environment is a big concern; it will not lead to sustainable development. Strezov et al. (2016) [2] try to construct a normalized average sustainability index by considering nine indices covering three central dimensions: economic, environmental, and social. It tries to analyze how much is the deviation of individual indices from the average sustainability index. An economic and environmental index such as Change in Wealth Index(CWI), Ecological Footprint (EF), Environmental Performance Index (EPI), Environmental Sustainability Index (ESI), Genuine Savings Index (GSI), Global Well-Being Index (GWI), Happy Planet Index (HPI), Human Development Index (HDI) and Sustainable Society Index (SSI) is used to construct the index. The study's main finding is economic indices, GWI, and HDI have very low variability in explaining the average sustainability index. The result focuses on other dimensions; human health and other species and ecosystems' health in achieving sustainable development goals. Rosa *et al.* (2016) investigate whether countries across the world differ in sustainability, focusing on the level of income. Results show that economic and social factors have a direct link with high incomes. In contrast,

environmental factors are closer to nations with a low level of income. Because in countries where the income level is middle or low, more focus is on environmental issues.

There are many other factors which directly or indirectly affect sustainable development. According to Ibaba (2009) [5], violence is an essential factor which hinders sustainable development goals. The violence hurts human lives and the environment; thereby, it constrains the improvement of production capabilities, poverty alleviation, and wealth creation. Another study by Christophersen and Stave (2018) was based in Myanmar to understand the impact of conflicts on development. The study finds that the country's internal conflicts are the biggest hindrance for them to attain sustainable development goals. All the conflicts hinder the development goals of the country.

All the sectors in a country should work together to attain a sustainable development goal. For instance, many governments mandated corporate social responsibility; it will contribute towards sustainable development. Weber (2014) [11] finds that sustainability concerns help a company add value to their business and suggest that it aims to gain its development through sustainable development. The paper also suggests that to address the sustainability issues, the financial sector should change from an outside-in strategy to an inside-out approach.

The study conducted by Evans et al. (2016) [10] raises the concern about the sustainability of non-renewable resources due to its limited availability in nature. Non- renewable resources like fossil fuels are used heavily for electricity generation. They cause a hazardous impact on environmental degradation by emitting greenhouse gases and other pollutants in the atmosphere. They try to find more sustainable electricity generation technology by considering greenhouse gas emissions, land use, and water use. There is a dire need to shift from non- renewable to renewable sources of energy consumption, such as biomass, to move towards a sustainable future.

Over the last few decades, various governments and international institutions are working towards achieving development goals. However, despite all these efforts as a planet, we are still far from achieving the desired output. (Howes, 2017) [4] says that this situation is due to massive failure in policy implementation. All countries are governed by politicians who care more about economic growth than environmental development because it is easy for journalists to question GDP compared to questioning the environment. (Jesinghaus, 2012) [6] One of the important reasons why usability Environmental Performance Index (EPI) is low is that they are not tailored for understanding common masses.

Moreover, many studies highlight that with increase in globalization and technological advancement, the variation in many economic and environmental phenomena has also increased. For example, climate change is happening at an alarming rate, even quicker than many recently published studies estimated (Richardson, 2009). Therefore, we need improved indexes, giving us a better indication for moving towards a sustainable future. (Dahl, 2012) [1].

3. Objective

This paper is an inquiry on sustainable development goals. The 2030 agenda for sustainable development is aimed at universal peace. The universal sustainability agenda involves 169 targets and 17 sustainable development goals. To attain this goal, there should be a balance between environmental, social, and economic factors. We are living in a world where there are significant challenges to sustainable development. In most countries, the majority of people are still living in poverty. Gender inequalities and opportunity disparities are other challenges for attaining sustainability goals. Water scarcity, loss of biodiversity, climate change, and drought have a direct impact on the environment, affecting sustainability.

Social and economic factors can be controlled through proper strategies and decision making. Environmental factors are not so easily controllable. The difficulty in accurately measuring the impact poses a big problem. Hence, it becomes an arduous task to take corrective measures and find an immediate positive change in the environment. Hence this study is an attempt to observe the environmental factors and its influence on the sustainability index. In this study, the paper considers the 2020 data. As we know, the situation in 2020 is different due to the COVID 19 pandemic. The data that has been considered in this paper does not include the COVID 19 impacts. The impact of Covid 19 on these variables will be factored in the 2021 report.

4. Data and variables

Our analysis is based on cross-sectional data collected from different data sources across 112 countries for the year 2020. We have identified the sustainable Development Goal Index (SDGI) as our dependant variable, which was taken from the Sustainability Report 2020 published by World Bank. The independent variables acting as a proxy for environmental factors are Unsafe Drinking Water (UWD), Tree Cover Loss (TCL), adjusted CO2 emissions (CDA), and Climate Change (CCH) taken from the Environmental Performance Index 2020. The study first identifies the sustainable goals focused on environmental protection and climate change from the SDG report. The explanatory variables for environmental factors were decided based on those particular goals. The expected years of schooling of the countries (EYS), percentage of the unemployment rate (UE), Gini-coefficient (GINI), and GDP per capita is taken as the control variables. The initial sample was collected for 167 countries. Due to data unavailability and missing data for specific indicators, the final sample has been reduced to 113 countries.

EPI defines UWD as "the number of age-standardized disability-adjusted life years (DALY) lost per 100000 when exposed to unsafe drinking water." It is expressed as a score ranging from 0 to 100 with 0 being the worst and 100 the best-performing country. A score of 100 denotes that the country has a very low DALY rate and a relatively safe and healthy environment with less contaminated drinking water. One primary goal of SDG is to provide clean water and sanitation.

Tree Cover loss measures the average loss of forest area in the past five years divided by forest area's total extent in the year 2000. A score of 0 denotes the worst performance, and 100 denotes the best with almost no forest loss. SDG aims to reduce forest loss, improve biodiversity, and contribute more financial support for its protection. An increased attempt to conserve forests is an indication of a country's progress toward sustainable development.

Adjusted CO_2 emission measures the annual average rate of emission of the countries from the year 2008 to 2017. A score of 100 indicates that the country has cut down its emissions more than or equal to 7.59% per year and a score of 0 indicates worst performance. Climate change measures the advancement in dealing with global climate change by countries which is a major threat to human safety, health and well-being. It is an indicator measured as a combination of 8 factors contributing to climate change combating. SDG goals have stressed upon the need of policies for climate change mitigation and adaptation. The alarming increase in emissions, especially CO2 emission over the past decade has made it a priority concern to monitor.

The control variables have been taken after considering the social and economic dimensions of the sustainable development goals. The expected years of schooling measures the average number of completed education by individual of age of 25 years or more. It was taken from the Human Capital Index 2020. Unemployment rate is that percentage of total labour force out of work. Gini Coefficient measures the income and wealth distribution across the countries which has a range of score from 0 (perfect equality) to 1(perfect inequality). GDP per capita measures the GDP of a country divided by its population. Unemployment rate, population, and GDP per capita was taken from the Economic Freedom Index of 2020. Gini coefficient was taken from World Bank. The natural log of GDP per capita and population was taken for the purpose of scaling.

3.1 Descriptive statistics of variables

Table 3.1: Descriptive statistics of the dependent and explanatory variables related to environment

	SDGI	UWD	TCL	CDA	CCH
Mean	37.9369010718.1473214336.4758928612.6330357152.10089286				
Standard Error	.933639574 2.7486810812.1530272771.9191670171.561073027				
Median	70.24554309	48.2	31.85	42.85	52.65
Mode	-	100	100	57.9	60.2
Standard Deviation	9.880712511 29.089306292 2.785498972 0.310554611 6.52084403				
Kurtosis	).934227187).892413023 1.910698964).328845198).516257428				
Skewness	).429233706 .307619667 1.544059301).102846139).111072222				
Range	37.60290882	98.4	98	99.7	82.5
Minimum	17.12115385	1.6	2	0.3	12.5
Maximum	34.72406267	100	100	100	95
Sum	7608.93292	5392.5	4085.3	4774.9	5835.3
Count	112	112	112	112	112

4. Research methodology

The data has been analysed using STATA software package. The impact of the environmental variables on sustainable development index has been analysed by using an OLS multiple regression model. The model developed is:

$$SDGI = \beta_0 + \beta_1 UWD + \beta_2 TCL + \beta_3 CDA + \beta_4 CCH + \beta_5 EYS + \beta_6 UE + \beta_7 GINI + \ln\beta_8 POP + \ln\beta_9 GDP + \varepsilon_i$$

Here, β_0 denotes the intercept

β_1, β_2, β_3, ……. B_9 represents the coefficients of respective regressors

ε denotes the stochastic error term

Testing of hypothesis

Hypothesis 1 – when the score of unsafe drinking water is high in a country, SDGI should be low

Hypothesis 2 – when the score of tree cover loss is high in a country, SDGI should be low

Hypothesis 3 – when the adjusted C02 emissions of a country increases, SDGI should increase

Hypothesis 4 – when the attempts of a country to tackle climate change increases, SDGI should increase

In this paper, multicollinearity was checked in two ways. Presence of high adjusted R^2 value when individual coefficients were showing insignificance was checked. An alternative method, Variance Inflation Factor (VIF) was used to check multicollinearity. The presence of variance in error terms indicates heteroscedasticity, which is a violation of Gauss-Markov theorem assumption. Breusch Pagan test was used to detect heteroscedasticity.

5. Results

Table 5.1: Regression results of the model

Source	SS	df	MS	Number of obs	=	112
				F(8, 103)	=	79.88
Model	9332.51069	8	1166.56384	Prob > F	=	0.0000
Residual	1504.25043	103	14.6043731	R-squared	=	0.8612
				Adj R-squared	=	0.8504
Total	10836.7611	111	97.6284786	Root MSE	=	3.8216

sdgi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
uwd	.1110173	.0286228	3.88	0.000	.0542509	.1677838
tcl	-.0023194	.0177235	-0.13	0.896	-.0374697	.0328309
cda	-.0401324	.0530748	-0.76	0.451	-.1453937	.0651289
cch	.1421351	.0668036	2.13	0.036	.009646	.2746242
eys	1.453086	.2751634	5.28	0.000	.9073644	1.998808
ue	-.0272879	.0750498	-0.36	0.717	-.1761315	.1215557
gini	-7.314451	5.938844	-1.23	0.221	-19.09275	4.463845
lngdp	1.717611	.7547149	2.28	0.025	.2208119	3.21441
_cons	29.7047	6.317207	4.70	0.000	17.17601	42.23339

Table 5.2: Correlation matrix and variance inflation factor of the independent variables

```
. corr uwd tcl cda cch eys ue gini lngdp
(obs=112)
```

	uwd	tcl	cda	cch	eys	ue	gini	lngdp
uwd	1.0000							
tcl	-0.0002	1.0000						
cda	0.7215	-0.1299	1.0000					
cch	0.7163	-0.1364	0.9383	1.0000				
eys	0.7633	-0.1542	0.6578	0.6658	1.0000			
ue	-0.0180	0.2197	0.1402	0.1630	-0.0143	1.0000		
gini	-0.0518	-0.2627	0.0674	0.0610	0.0782	-0.0137	1.0000	
lngdp	0.8715	-0.0302	0.7130	0.7335	0.7914	0.0424	0.0657	1.0000

```
. vif
```

Variable	VIF	1/VIF
cch	9.26	0.108018
cda	8.83	0.113224
lngdp	5.50	0.181941
uwd	5.27	0.189789
eys	3.07	0.325779
tcl	1.24	0.806762
ue	1.17	0.858053
gini	1.14	0.877935
Mean VIF	4.43	

Table 5.3: Breusch Pagan test for heteroscedasticity

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of sdgi

         chi2(1)      =     0.49
         Prob > chi2  =   0.4834
```

5.1 Interpretation

In the regression analysis, we found that ceteris paribus, when the score of unsafe drinking water increased by 1-point, the country's sustainable development goal index score also increased by 0.11 units (1% and 5% significance). This result is opposite to our expectation of the variables having a negative relation. Climate change also reported having a significant relation with the SDGI score as the p-value is less than 0.05. A one-unit change in the indicator caused a 0.14-unit increase in the SDG index at 5% significance ceteris paribus. As expected, climate change had a positive impact on SDGI. The variables tree cover loss and adjusted CO2 emission were found insignificant. Tree cover loss was found to have the expected negative impact on SDGI, but adjusted C02 emissions reported a negative effect on SDGI as opposed to what was expected. Mean years of schooling and ln GDP were found to be significant at 5% level of significance. Gini coefficient and the unemployment rate were found to have an insignificant impact on SDGI at 5% significance.

The overall goodness fit of the model was checked through the adjusted R squared value. A high value of 0.84 was reported which denotes that the explanatory variables explain 84% of the SDGI. F statistic of regression results was reported as 79.8 which is less than the p-value at 5% level of significance. This implies that the model fits the data and predicts the results better than the average.

A high adjusted R squared and a smaller number of the individual significance of coefficients were found, which might have been because of multicollinearity.

For testing multicollinearity, a correlation matrix was formed. A high correlation was found between climate change and adjusted CO2 emission (0.93). The data showed that the Variance Inflation Factor mean VIF was 4.43. According to the thumb rule, the mean VIF value falling below 10 indicates no multicollinearity. Hence, we concluded the same for our overall model.

Breusch Pagan test was conducted to check the presence of heteroscedasticity in the model. Since the p-value (0.48) was less than the Chi-squared statistic (0.49), we failed to reject the null hypothesis that the error terms are homoscedastic.

5. Conclusion

This research's main focus was to examine the relationship between environmental factors and sustainable development goal index. According to our findings, unsafe drinking water (UWD) and climate change (CCH) were statistically significant in explaining the relationship with SDGI. These results align with our expectations, as goals 6 and 13 of sustainable development focus on the accessibility of clean water, sanitation, and climate action, respectively. The expected nature of relation with unsafe drinking water score and SGDI was positive, but our results showed a negative relationship. It might be because of increased economic activities and production releasing high emissions, thereby contaminating the water. Other indicators related to GDP and production of SDGI can contribute to the high ranking of those countries.

However, $C0_2$ emission, one of the major contributing factors to negatively affect climate, was found insignificant. This contrasts with SDGI's aim for climate action, which emphasized the immediate need to control the emission rates. Furthermore, our fourth variable, tree cover loss (TCL) was again found insignificant, which is again not in sync with goal 15 of sustainable development. This goal talks about life on land and focuses on saving forests and wildlife on the planet. Therefore, this study highlights the fact that less importance might have been given to C02 emission adjustment level and loss of plantation while constructing the SDG index, or those countries might have had high scores on their economic and social indicators. Policy formations can thus be done by countries that focus on these factors, helping achieve environmental sustainability. Care should be taken to make tailor-made policies and agendas taking into consideration the unique socio, economic and environmental characteristics of each country.

The study has many limitations, which could also contribute to some insignificant results and give relations not according to theory. Due to missing values for certain indicators and data not reported for specific countries, the sample size has been dramatically reduced and could have contributed to certain anomalies in the result. We had taken only 4 out of 46 indicators from the EPI index as our proxy for explanatory variables. Including more variables can give a more comprehensive understanding. Control variables were also limited to 4. C02 emission adjustments and climate change are correlated, which results in high multicollinearity. This might have led to the coefficient being insignificant. This study is limited to the year 2020 and did not include the past year trends in the SDG index. The robustness check for the model could make our results stronger.

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