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# Steps toward Achieving Sustainable Development Goals: The Role of Carbon Finance, Green Social Behaviour and Awareness, Energy Transition, and Government Governance in E7 Countries

**Firas Al-Rawashdeh[1]*, Mahmoud Barakat Alnawaiseh[2], Elham Hmoud Al-Faouri[3], Ramzi M. Altarawneh[4], Yaser Alsheyyab[5], Sanjar Mirzaliev[6]**

[1]Department of Finance, Faculty of Business, The University of Jordan, Aqaba, Jordan, [2]Department of Business, School of Business, University of Jordan, Aqaba, Jordan, [3]Department of Business Management, Faculty of Business, The University of Jordan, Aqaba, Jordan, [4]Faculty of Art and Educational Science, Middle East University, Amman, Jordan, [5]Costing and Network Economics at Orange Jordan, Amman, Jordan, [6]Department of Research and Innovations, Tashkent State University of Economics, Tashkent, Uzbekistan. *Email: f_rawashdeh@ju.edu.jo

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**ABSTRACT**

Sustainable development goals (SDGs) have become necessary for societies around the globe, and this requires academic and regulatory attention. Therefore, this study assesses the role of carbon finance, government governance, green behaviour and awareness, and energy transition, such as electricity production from water and solar sources, in achieving SDGs in the E7 countries. Secondary data is taken from the OECD, central banks, and WDI, covering the period 2001-2020. Continuously updated full modified (CUP-FM) and continuously updated bias-corrected (CUP-BC) approaches are employed to find the associations between the variables. The outcomes indicate that carbon finance, government governance, green behaviour and awareness, and electricity production from water and solar sources have a positive connection to SDG achievement in the E7 countries. The research offers guidance for policymakers in developing Sustainable Development Goals (SDGs) policies utilizing carbon finance, effective government governance, and green behavior and awareness.

**Keywords:** Carbon Finance, Government Governance, Green Behaviour and Awareness, Energy Transition, Electricity Production from Water Sources, Achievement of SDGs
**JEL Classifications:** Q01, B55, G34, O13, Q56

## 1. INTRODUCTION

The core focus of the world in recent decades has remained economic issues such as inflation, deflation, and deficits. This focus on economic issues results in the world ignoring other factors such as environmental degradation, which are adversely affecting not only our present but also our future. Given the current situation, the world acknowledges that environmental issues adversely affect social life and the economy. Harmful emissions are the result of activities including the use of chemicals in industry, production of energy from fossil fuels, and pollution from vehicles. The world acknowledges the environmental effects on the upcoming generations, and countries have started to respond to these environmental issues by promoting environmentally friendly activities and green projects. The United Nations stated its environmental efforts in 2015 when it produced a roadmap to address 17 core issues called the sustainable development goals (SDGs) (Anser et al., 2025; Caiado et al., 2018; Fuso Nerini et al., 2019).

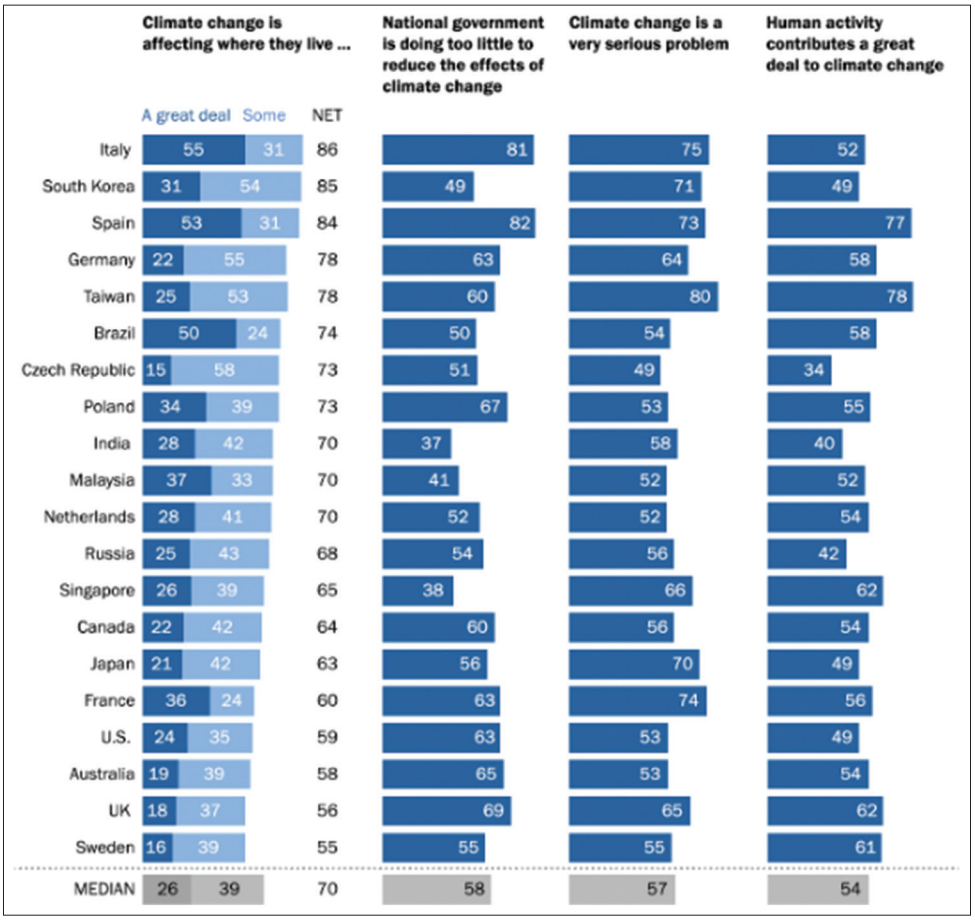
The world is abundant in natural resources (Pizzi et al., 2020). These resources are a free gift of nature and support countries in numerous ways including economically (Anser et al., 2025;

Moyer and Hedden, 2020; Sachs et al., 2019). Saving these important natural resources is key to a better future. Meanwhile, glaciers are melting and the levels of sea are rising as a result of the temperature of the world already being 1.1°C higher than before industrialization (Boluk et al., 2019; Chien et al., 2022). Other effects of climate change include flooding and drought, widening economic disparities, stifled economic progress, and even violence (Fuso Nerini et al., 2018; McCollum et al., 2018). To remain within the 1.5°C of warming which is the current objective, national pledges are insufficient and multiple efforts are needed.

To bring stability to the environment, the world must promote environmentally friendly activities such as the utilization of renewable energy sources such as wind, water, and solar, less use of chemicals in industries, and less burning of oil in vehicles (Anser et al., 2024; Zhang et al., 2025). A group of seven countries, comprising Brazil, China, India, Mexico, Russia, Indonesia, and Turkey, is known as the emerging seven (E7). These countries are seeing adverse effects on their environments which seriously threaten life on earth (Gyamfi et al., 2021). Similar to other nations, the E7 struggle to reduce their reliance on non-renewable energy (non-RE) sources by implementing eco-friendly technologies to protect the environment from further damage and fulfil the UN SDGs. The SDG scores of the E7 countries, which reflects their contributions to accomplish the SDGs are, for Brazil, India, Turkey, China, Russia, Mexico, and Indonesia, 72.80, 60.32, 70.41, 72.38, 74.07, 70.20, and 69.16, respectively. The highest score is held by Brazil (72.80) and the lowest by India (60.32). Accordingly, the ranking of the E7 countries is, for Brazil, India, Turkey, China, Russia, Mexico, and Indonesia, 53, 121, 71, 56, 45, 74, and 82, respectively. A great deal of effort is required by this group to ensure a reduction in environmental degradation with the view to achieving SDG13, climate action. Figure 1 illustrates the climate change situation.

Over the last few decades, the world has encountered numerous issues such as food security, hunger, poverty, and environmental changes, of which environmental changes are among the worst. The UN has designed a set of 17 goals to safeguard the future. The consequences of environmental change are much more serious than our analysis can reflect, and this could lead to a dark future for the coming generation. This study aims to fill a gap in the existing literature by the following ways: (1) there is much need to explore the SDGs particularly in E7 economies; (2) Morton et al. (2019) and Fuso Nerini et al. (2019) scrutinize the connection between the change of climate and SDGs, however the present investigation studies SDGs, carbon finance, green behaviour, solar electricity, water electricity and industrialization in the E7 countries using a fresh dataset; (3) the equation used includes SDGs, carbon finance, green behaviour and awareness, production of electricity from water sources, production of electricity from solar sources and industrialization in the E7 economies as variables, which have not been evaluated recently; (4) Sachs et al. (2019) study the association between carbon (i.e., green) finance and SDGs, while the current investigation studies

**Figure 1:** Climate change issues across the world



this relationship plus green behaviour and awareness, production of electricity from water sources, production of electricity from solar sources and industrialization in the E7 economies with a fresh dataset; (5) Chams and García-Blandón (2019) consider the adoption of SDGs, while the current paper scrutinizes SDGs along with green behaviour and awareness, production of electricity from water sources, production of electricity from solar sources and industrialization in the E7 economies with a fresh dataset; (6) Christ and Burritt (2019) consider the implementation of SDGs, while the present study considers SDGs along with green behaviour and awareness, electricity production from water sources, electricity production from solar sources and industrialization; and (7) Olabi et al. (2022) consider SDGs indicators, while the present study investigates SDGs along with green behaviour and awareness, electricity production from water sources, electricity production from solar sources and industrialization in the E7 economies. The literary contribution of the study is: (1) the study highlights the importance of SDGs and the need for their achievement to support the world; (2) the study offers support to the world with the aim of reviewing and upgrading policies in connection to the successful implementation of SDGs; and (3) although there are numerous aspects of SDGs which have been explored, there are still numerous factors which remain hidden, and therefore the study offers fresh evidence to explore the area more deeply.

## 2. LITERATURE REVIEW

This research investigates the impact of carbon finance, government governance, green behaviour and awareness, and energy transition, such as production of electricity from water and solar sources on achieving SDGs in the E7 countries. The ultimate remedy to mitigate environmental degradation is investment in environmentally friendly schemes such as green financing. In this context, Ronaldo and Suryanto (2022) investigate whether there is any relationship between carbon (i.e., green) finance and SDGs in Indonesia. The study takes 2020 sample data of Indonesian villages, analysed with Smart-PLS, and reveals that green financing has a positive influence on SDGs. Green financing may encourage the development of green microenterprises, which accomplish SDGs through environmental sustainability. Lee (2020) investigates whether green finance results in the achievement of SGDs in China. The investigation uses a dataset of 500 respondents and shows that China's prime aim is to mitigate environmental degradation due to industrialization, which is tough to achieve in the country. Green finance is an important tool for generating energy from renewable resources, which mitigates carbon emissions, and thus is essential for achieving SDGs, particularly in China. Global investment in energy efficiency and renewable energy (RE) fell by 3% in 2017, and there is a chance it will continue to fall (Jiakui et al., 2023). Clearly, Investment in energy still favors fossil fuels, potentially threatening green energy growth needed for energy security objectives, climate change mitigation, and clean air. Numerous developing economies continue to support coal-based energy programmes, and any reduction in emissions made by other countries is more than offset by the additional carbon dioxide ($CO_2$) produced by coal-fired power plants. Sinha et al. (2021) investigate whether green finance results in environmental sustainability. The results reveal that green finance positively affects the environment.

Governance is a vital factor in the success or failure of any country, and it is similar for the achievement of SDGs. Good governance can lead to better implementation of plans for SDG achievement. Glass and Newig (2019) investigate the role of governments attempting to achieve SDGs in 41 economies, using data from January to December 2015. The sample is analysed using multiple regression methods. The findings state that governance is key to achieving SGDs. Countries with good governance see a high level of SDG achievement. Omri and Ben Mabrouk (2020) investigate the role of governance in SDGs in 20 Middle Eastern and North African (MENA) economies, taking data from 1996 to 2014. The study indicates that political and institutional governance positively contributes to the three pillars of sustainable development (SD). There is bi-directional connection between human development and economic growth. High GDP leads to higher emissions which, at certain point, affects economic growth in a negative manner. Finally, increasing human development can effectively lessen carbon emissions. Martínez-Ferrero and García-Meca (2020) ask whether corporate governance plays a role in SDG achievement in 20 economies in the European Union. The investigation takes data from 2016 to 2017, analysed using several regression analyses. The study indicates that stronger internal corporate governance increases the likelihood of companies including Sustainable Development Goals (SDGs) in their sustainability reports. The findings support the idea that board independence and CEO non-duality play separate roles in determining how much a company contributes to the UN 2030 Agenda.

The 2030 Agenda and SDGs all over the world, may be implemented through renewable energy credits (RECs). Although RE was not included as one of the technologies for achieving the UN's millennium development goals (MDGs), it still indirectly contributed to achieving MDG objectives, particularly in Africa. Adenle (2020) scrutinizes solar energy opportunities with a view to meeting the SDGs in the 2030 Agenda in African economies. The findings show that Africa has plentiful opportunities for solar energy, which can lead to SDG achievement. Obaideen et al. (2021) explore solar energy and its effectiveness in achieving SDGs, and reveal that, when all stages are built and operational, the Mohammed bin Rashid Al Maktoum (MBR) Solar Park in the United Arab Emirates, will reduce an estimated 6.5 million tons of carbon dioxide equivalent emissions. Further research shows that the MBR Solar Park succeeds in achieving a number of SDGs, including SDG8, fair work and economic growth, SDG9, infrastructure, industry, and innovation, SDG 11, sustainable cities and communities, SDG 15, life on land, and SDG13, climate action. Güney (2022) explores solar energy and its role in SD, in 35 economies, taking data from 2005 to 2013. The findings show that SD is enhanced as a result of solar energy, while non-renewable energy inhibits the growth of sustainable systems. The study recommends giving solar energy priority in order for nations to achieve the UN SDGs.

Global warming is primarily caused by traditional energy production, primarily from fossil fuels like coal, leading to carbon emissions and environmental degradation. The world

is transitioning to renewable energy resources like water as an alternative (Buonomano et al., 2022; Giupponi and Gain, 2017). It is argued that high energy consumption, water pollution, soil erosion, carbon emissions, waste management, and food preservation are challenges that put a significant strain on regional and SD goals. Wang et al. (2021) investigate whether the water-energy nexus has any impact on the environment in connection with SDGs. They review the water-energy nexus in terms of their link to one another and their viability for achieving environmental sustainability. The investigation concludes that the water-energy nexus has a strong effect on the environment in terms of environmental sustainability and SDG13, climate action. Ke et al. (2022) explore the water-energy nexus and its connection to SDGs in China, using a dataset covering 21 years from 2000 to 2021, and an analytical approach. The results indicated that enhancing energy and water efficiency are essential for the nation to reduce energy and water consumption, meet resource needs, achieve environmental protection goals, and promote rapid economic growth. Economic growth has the potential to narrow the regional energy and water efficiency gaps, while an overheated economy has the potential to exacerbate gaps and lead to unsustainable and inefficient use of resources. Energy and water efficiency policy implementation are directly influenced by government coordination and objectives, as a component of efficient governance, which is essential for continual progress.

Changes in individual behaviours are key to changing the community psyche. Employee and customer behaviour is key to an organization's success or failure. Firms formulate specific strategies to develop or change the individual psyche (Trudel, 2019). The world is facing global warming due to carbon emissions and industrialization, which will have horrible consequences for future generations. To mitigate these consequences there is a need to change individual behaviour by convincing people of the benefits of green projects (Indriani et al., 2019). As individual behaviour and environmental degradation share a significant connection, Han (2021) investigates consumer behaviour and environmental sustainability in the tourism industry, concluding a significant connection between consumer behaviour and the environment. A change in consumer behaviour is negatively associated with environmental degradation. May et al. (2021) investigate the role of corporate social responsibility (CSR) and employee green behaviour in environmental sustainability in Malaysia. The investigation uses data on 213 employees, analysed with Smart-PLS. A significant association is found between employee green behaviour and environmental sustainability.

Countries expand their revenue generation projects with the aim of making their economies stable. One major source of economic stability is the expansion of business, which leads to an increase in industry size. There is a significant impact between industrialization and environmental SDGs. Patnaik (2018) investigates whether there is any association between industrialization and SDGs in terms of the environment in the South Indian region. The investigation takes data from 2000 to 2015, analysed using casual chain analysis. The findings suggest a significant positive impact between industrialization and SDGs. Cherniwchan (2012) investigates whether industrialization affects the achievement of SDG13 in 157 economies, taking data from 1970 to 2000, analysed using the autoregressive distributed lag (ARDL) approach. The outcomes reveal that a change in industrialization leads to a change in the environment, and the nature of this association is positive. A 1% change in industrialization results in about an 11% change in environmental degradation. India is one of the countries badly affected by environmental degradation, primarily impacted by rapid industrialization and expansion of both small and large firms, which is of great economic significance. The government aggressively promotes the growth of the small business sector, because it is concerned with boosting economic development and the standard of living for its citizens. D'Souza and Peretiatko (2002) Investigated the association between industrialization and the environment in India, using a dataset of 400 respondents. The study revealed a positive association between industrialization and SDGs in terms of environmental change.

## 3. METHODOLOGY

This research investigates the impact of carbon finance, government governance, green behaviour and awareness, and production of electricity from water and solar sources on the accomplishment of SDGs in the E7 countries. The E7 countries are China, Mexico, India, Russia, Brazil, Indonesia, and Turkey. OECD, central bank, and WDI databases are used to retrieve data from 2001 to 2020. The research equation is:

$$SDG_t = \alpha_0 + \beta_1 CF_t + \beta_2 GG_t + \beta_3 GBA_{it} + \beta_4 EPWS_t + \beta_5 EPSS_t + \beta_6 IND_t + e_t \quad (1)$$

Where:
*SDG* = sustainable development goals
*t* = time period
*i* = countries
*CF* = carbon finance
*GG* = government governance
*GBA* = green behaviour and awareness
*EPWS* = electricity production from water sources
*EPSS* = electricity production from solar sources
*IND* = industrialization.

The research adopts the SDGs as the dependent variable measured by the SDG index given by the OECD. The research also adopts four independent variables, a carbon finance proxy (the ratio of green finance to total finance), a government governance proxy (the ratio of expenditure on sustainable development to total expenditure), a green behaviour and awareness proxy (carbon taxes as a percentage of revenue), and energy transition proxies (production of electricity from water sources as a percentage of the total, and production of electricity from solar sources as a percentage of the total). Finally, the research applies one control variable, an industrialization proxy (industry value added as a percentage of GDP). These proxies of the variables are listed in Table 1.

The research applies descriptive statistics, year-wise descriptive statistics, and the correlations between the variables. It examines the cross-sectional dependence (CSD) by applying the Breusch

and Pagan Lagrange multiplier (BP-LM) test, the Pesaran scaled Lagrange multiplier (PS-LM) test, and the Pesaran cross-sectional dependence (P-CD) test. The PS-LM test equation is:

$$\mathrm{LM}_2 = \sqrt{\frac{1}{\mathrm{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T_{ij}\hat{\rho}_{ij}^2 - 1\right)} \to N(0,1) \quad (2)$$

The P-CD test equation is:

$$CD = \sqrt{\frac{2}{N(N-1)}}\sum_{i=}^{N-1}\sum_{j=i+1}^{N} T_{ij}\hat{\rho}_{ij}^2 \to N(0,1) \quad (3)$$

Finally, the BP-LM test equation is:

$$LM_1 = \sum_{i=1}^{N-1}\sum_{j=i+1}^{N} T_{ij}\hat{\rho}_{ij}^2 \to X^2\,\frac{N(N-1)}{2} \quad (4)$$

The research evaluates the unit root by applying the cointegrated augmented Dickey Fuller (CADF) test, the equation for which is:

$$X_{it} = \alpha_i + b_i X_{it-1} + c_i \bar{X}_{it-1} + d_i \Delta\bar{X}_t + e_{it} \quad (5)$$

The study checks the cross-sectional dependence (CSD) issue by applying the cross-sectionally augmented Im, Pesaran, Shin (CIPS) test developed by Pesaran (Sarkodie and Strezov, 2019). The CIPS equation is:

$$\Delta W_{i,t} = \varnothing_i + \varnothing_i Z_{i,t-1} + \varnothing_i \bar{Z}_{t-1} + \sum_{l=0}^{p}\varnothing_{il}\Delta\bar{W}_{t-1} + \sum_{l=0}^{p}\varnothing_{il}\Delta W_{i,t-1} + \mu_{it} \quad (6)$$

where, $\bar{W}$ is the average cross-section:

$$W^{i,t} = \varnothing^1\overline{CF}^{i,t} + \varnothing^2\overline{GG}^{i,t} + \varnothing^3\overline{GBA}^{i,t} + \varnothing^4\overline{EPWS}^{i,t} + \varnothing^5\overline{EPSS}^{i,t} + \varnothing^6\overline{IND}^{i,t} \quad (7)$$

**Table 1: Variables and measurements**

| S. No. | Variable | Measurement | Source |
|---|---|---|---|
| 01 | Sustainable development goals | SDG index | OECD |
| 02 | Carbon finance | The ratio of green finance to total finance | Central banks |
| 03 | Government governance | The ratio of expenditure on sustainable development to total expenditure | Central banks |
| 04 | Green behaviour and awareness | Carbon taxes (% of revenue) | WDI |
| 05 | Energy transition | Electricity production from water sources (% of total) | WDI |
| | | Electricity production from solar sources (% of total) | WDI |
| 07 | Industrialization | Industry value added (% of GDP) | WDI |

The equation related to the CIPS test is:

$$\widehat{CIPS} = N^{-1}\sum_{i=1}^{n} CADF \quad (8)$$

The research examines the co-integration by applying the Westerlund and Edgerton (2008) approach, the equations for which are:

$$LM_{\varphi}(i) = T\hat{\varphi}_i(\hat{r}_i / \hat{\sigma}_i) \quad (9)$$

$$LM_{\tau}(i) = \hat{\varphi}_i / SE(\hat{\varphi}_i) \quad (10)$$

Where, $\hat{\varphi}_i$ represents the approximation against $\hat{\sigma}_i$, $\hat{r}_i^2$ represents the long-run assessed variance, $\varphi i\ (L) = 1 - \sum \varphi_{ij}L^j$ represents a scalar polynomial, and $\rho_i$ represents the factor loading parameters vector.

Finally, the research employs CUP-FM and CUP-BC approaches to find the associations among the variables. These approaches are developed by Bai et al. (2009), and provide a robust estimation. The approach produces factor loadings, a covariance matrix estimation, and continuous parameters until convergence is achieved. The research equation is:

$$\beta_{cup} = \left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{y}_{it} + \hat{\beta}_{cup}\right)\left(x_{it} - \bar{X}_i\right)' - T\left(\hat{\lambda}'_i\left(\hat{\beta}_{CUP}\right)\hat{\Delta}_{F\varepsilon i}\left(\hat{\beta}_{CUP}\right) + \hat{\Delta}_{u\varepsilon i}\left(\hat{\beta}_{CUP}\right)\right)\right] \times\left[\sum_{i=1}^{N}\sum_{t=1}^{T}\left(x_{it} - \bar{X}_i\right)\left(x_{it} - \bar{X}_i\right)'\right] \quad (11)$$

Where, $\hat{\Delta}_{F\varepsilon i}$ and $\hat{\Delta}_{u\varepsilon i}$ are one-sided estimated covariance.

## 4. RESEARCH FINDINGS

The research applies descriptive statistics to the constructs, showing the average values, minimum and maximum values, total observations, and standard deviations. The statistics reveal that the SDG average value is 107.845%, GF mean value is 2.562%, GG average value is 89.720%, and GBA mean value is 90.026%. The outcomes reveal that EPWS is 22.667%, while EPSS is 26.373%, and the IND mean value is 32.315%. Table 2 precents these figures.

The year-wise descriptive statistics show that SDG is highest in 2020, GF in 2001, GG in 2020, and GBA in 2020. In addition,

**Table 2: Descriptive statistics**

| Variable | Obs | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|---|
| SDG | 140 | 107.845 | 40.315 | 31.798 | 263.224 |
| GF | 140 | 2.562 | 1.628 | 0.487 | 9.612 |
| GG | 140 | 89.720 | 15.102 | 57.350 | 116.36 |
| GBA | 140 | 90.026 | 14.336 | 59.360 | 116.38 |
| EPWS | 140 | 22.667 | 21.367 | 5.295 | 84.021 |
| EPSS | 140 | 26.373 | 20.365 | -3.948 | 64.610 |
| IND | 140 | 32.315 | 8.187 | 17.702 | 48.061 |

EPWS is highest in 2004, while EPSS is highest in 2019, and IND is highest in 2008. These values are given in Table 3.

SDG is highest in Turkey, GF in Russia, GG in Mexico, and GBA in Indonesia. The highest EPWS value is in Brazil, while the highest EPSS value is in Mexico, and the highest IND value is in China. These values are summarized in Table 4.

The correlation among the variables is determined by applying the correlation matrix. The outcomes reveal that carbon finance, government governance, green behaviour and awareness, and electricity production from water and solar sources have positive links to the achievement of SDGs in the E7 countries. Table 5 gives the full details.

The research examines the CSD by applying the BP-LM, PS-LM, and P-CD tests. The outcomes reveal that the P-values are <0.05 and the t-values are >1.96. These figures indicate no CSD issues. Table 6 provides the details.

**Table 3: Descriptive statistics (by year)**

| Year | SDG | GF | GG | GBA | EPWS | EPSS | IND |
|---|---|---|---|---|---|---|---|
| 2001 | 54.237 | 3.800 | 68.116 | 68.719 | 25.251 | 21.074 | 33.196 |
| 2002 | 59.379 | 3.631 | 69.340 | 70.283 | 25.181 | 22.025 | 32.673 |
| 2003 | 64.365 | 3.431 | 71.384 | 72.880 | 24.254 | 23.595 | 32.081 |
| 2004 | 68.256 | 3.095 | 73.729 | 74.604 | 25.746 | 23.195 | 33.388 |
| 2005 | 72.655 | 2.870 | 75.784 | 76.434 | 25.247 | 23.191 | 33.989 |
| 2006 | 77.337 | 2.669 | 78.536 | 79.001 | 25.075 | 24.030 | 34.426 |
| 2007 | 81.963 | 2.363 | 80.276 | 81.081 | 24.109 | 25.608 | 34.163 |
| 2008 | 88.821 | 2.139 | 85.711 | 85.523 | 23.623 | 26.258 | 34.421 |
| 2009 | 94.035 | 2.331 | 84.460 | 85.713 | 23.725 | 27.231 | 33.122 |
| 2010 | 100.000 | 2.074 | 85.003 | 86.526 | 24.580 | 27.752 | 32.874 |
| 2011 | 106.397 | 1.941 | 91.997 | 91.117 | 23.692 | 26.739 | 33.359 |
| 2012 | 112.480 | 1.997 | 92.327 | 92.911 | 22.858 | 26.773 | 32.868 |
| 2013 | 119.520 | 1.981 | 96.751 | 96.467 | 22.387 | 27.536 | 32.024 |
| 2014 | 126.800 | 2.077 | 98.120 | 98.020 | 20.720 | 28.583 | 31.526 |
| 2015 | 135.630 | 2.384 | 100.311 | 100.526 | 21.156 | 27.675 | 30.744 |
| 2016 | 143.018 | 2.444 | 101.567 | 101.453 | 20.282 | 28.590 | 30.109 |
| 2017 | 149.923 | 2.343 | 108.344 | 107.453 | 19.715 | 29.062 | 30.667 |
| 2018 | 158.322 | 2.459 | 109.011 | 109.051 | 19.149 | 29.535 | 31.098 |
| 2019 | 167.430 | 2.509 | 110.659 | 110.459 | 18.582 | 30.007 | 30.154 |
| 2020 | 176.341 | 2.692 | 112.969 | 112.296 | 18.015 | 29.008 | 29.422 |

**Table 4: Descriptive statistics (by country)**

| Country | SDG | GF | GG | GBA | EPWS | EPSS | IND |
|---|---|---|---|---|---|---|---|
| China | 102.743 | 4.153 | 87.769 | 88.013 | 16.864 | 1.657 | 43.863 |
| India | 109.951 | 3.390 | 89.073 | 88.384 | 11.974 | 8.034 | 28.341 |
| Brazil | 110.347 | 0.853 | 87.826 | 88.043 | 72.026 | 9.398 | 21.482 |
| Turkey | 117.625 | 1.471 | 95.145 | 89.561 | 22.764 | 43.945 | 26.566 |
| Russia | 108.088 | 4.412 | 87.156 | 89.062 | 16.591 | 48.479 | 30.289 |
| Mexico | 103.161 | 1.307 | 91.093 | 92.074 | 11.060 | 51.595 | 32.139 |
| Indonesia | 103.002 | 2.343 | 89.976 | 95.044 | 7.393 | 21.505 | 43.526 |

**Table 5: Matrix of correlations**

| Variable | SDG | GF | GG | GBA | EPWS | EPSS | IND |
|---|---|---|---|---|---|---|---|
| SDG | 1.000 | | | | | | |
| GF | 0.158 | 1.000 | | | | | |
| GG | 0.863 | −0.253 | 1.000 | | | | |
| GBA | 0.889 | −0.190 | 0.958 | 1.000 | | | |
| EPWS | 0.062 | −0.395 | −0.149 | −0.187 | 1.000 | | |
| EPSS | 0.100 | −0.173 | 0.182 | 0.149 | −0.309 | 1.000 | |
| IND | 0.184 | 0.402 | −0.175 | −0.049 | −0.564 | −0.224 | 1.000 |

The research scrutinizes the unit root through the CADF and CIPS tests. The outcomes reveal that GF, GG, and EPSS have no unit root at level, but SDG, GBA, EPWS, and IND have no unit root at first difference. These values are given in Table 7.

Co-integration is examined using the Westerlund and Edgerton (2008) approach. The outcomes show that the P-values are <0.05 and the t-values are >1.96. These figures indicate that co-integration exists. The values are given in Table 8.

The research investigates the impact of carbon finance, government governance, green behaviour and awareness, and energy transition, such as electricity production from water and solar sources, on achieving SDGs in the E7 countries. The research employs the CUP-FM and CUP-BC approaches to find the associations between the variables. The outcomes indicate that carbon finance, government governance, green behaviour and awareness, and electricity production from water and solar sources are positively connected with the achievement of SDGs in the E7 countries. The values are given in Table 9.

**Table 6: CSD test results**

| Variable | Breusch-Pagan LM | Pesaran scaled LM | Pesaran CD |
|---|---|---|---|
| SDG | 33.901*** | 4.201*** | 3.290*** |
| GF | 27.290*** | 5.919*** | 11.272*** |
| GG | 12.977*** | 6.144*** | 8.201*** |
| GBA | 21.772*** | 4.391*** | 5.393*** |
| EPWS | 10.562*** | 4.377*** | 9.003*** |
| EPSS | 32.622*** | 3.999*** | 32.901*** |
| IND | 10.181*** | 7.091*** | 23.888*** |

**Table 7: CADF and CIPS unit root tests results**

| Variable | CIPS | | CADF | |
|---|---|---|---|---|
| | Level | 1st difference | Level | 1st difference |
| SDG | ---- | −4.882*** | ---- | −4.673*** |
| GF | −2.882*** | ---- | −3.783*** | ---- |
| GG | −2.019*** | ---- | −3.887*** | ---- |
| GBA | ---- | −5.817*** | ---- | −5.772*** |
| EPWS | ---- | −4.373*** | ---- | −6.101*** |
| EPSS | −3.553*** | ---- | −2.382*** | ---- |
| IND | ---- | −5.771*** | ---- | −4.882*** |

**Table 8: Co-integration test results**

| Model | No shift | | Mean shift | | Regime shift | |
|---|---|---|---|---|---|---|
| | t-value | P-value | t-value | P-value | t-value | P-value |
| $LM_{\tau}$ | −4.342 | 0.000 | −5.553 | 0.000 | −6.493 | 0.000 |
| $LM_{\varphi}$ | −4.937 | 0.000 | −5.409 | 0.000 | −6.1 | 0.000 |

**Table 9: CUP-BC and CUP-FM test results**

| Variable | CUP-FM | | CUP-BC | |
|---|---|---|---|---|
| | Coefficient | t-stat | Coefficient | t-stat |
| GF | 0.893*** | 4.902 | 0.782*** | 5.492 |
| GG | 2.191*** | 4.977 | 1.291*** | 4.112 |
| GBA | 1.277*** | 5.099 | 4.210*** | 4.102 |
| EPWS | 0.774*** | 3.885 | 1.100*** | 3.211 |
| EPSS | 2.192** | 2.119 | 2.019** | 2.012 |
| IND | 5.362*** | 4.091 | 2.144*** | 4.066 |

## 5. DISCUSSION

This research investigates the impact of carbon finance, government governance, green behaviour and awareness, and energy transition, such as electricity production from water and solar sources, on achieving SDGs in the E7 countries. The results show that carbon finance is linked positively to SDGs, in line with the study of Yoshino et al. (2021), which indicates that, in an economy where carbon finance circulates through green credits, green securities, and green investment, business accompanied by carbon prevention practices is easy to carry out. Therefore, the speed of economic performance, level of employment, and national development are not affected by pollution from production. Hence, the study confirms that carbon finance makes a positive contribution to SDGs achievement. These results aligned with Barbier and Burgess (2020), who explain that, with the availability of special carbon finance with appropriate interest, businesses and non-profit making organizations initiate eco-friendly practices such as changes in resources consumption patterns, materials, and processes. This creates huge wealth, enhances employment, reduces poverty, and encourages sustainable economic development.

The results show that government governance positively influences SDGs, in line with the study of Chen et al. (2020), which asserts that governments making suitable changes to monetary, fiscal, political, economic, and social policies to govern individuals and organizations, assures peace, progress, and prosperity along with economic stability, which is the basis of sustainable development. Thus, government governance is helpful for attaining SDGs. These results agree with Bouma et al. (2019), who state that governments protect the environment from polluting activity through heavy taxes or punishments. Similarly, governments govern organizations by allowing them subsidies for eco-friendly strategy implementation. These firms focus on SDGs through innovations in clean water and sanitation, clean energy, workers' health and well-being, infrastructure, decent work, and economic growth.

The results indicate that green behaviour and awareness positively influence SDGs. These results are confirmed with the study of Zamora-Polo et al. (2019), which checks the contribution of green social awareness and behaviour to SDG achievement. The study shows that, when people of a country have high green awareness, they don't allow businesses to cause the environment to be polluted. Rather, they encourage the establishment of businesses that have eco-friendly policies. Consequently, a green economy is in a better position to attain SDGs. These results match with Chams and García-Blandón (2019), who indicate that green behaviour by people puts pressure on organizations to use green business models, and the green behaviour of organizational personnel motivates them to minimize the impact of business operations on the environment and human health. Hence, a country with higher environmental performance can better achieve SDGs.

The results reveal that electricity production from water positively influences SDGs. These results are confirmed with the study of Shaktawat and Vadhera (2021), which appears that an increase in electricity output applying hydropower enhances total energy supply in the market. A business with an electricity supply which comes from renewable energy rather than fossil fuel can operate the same machinery with fewer environmental issues. The increase of the environmental performance of the businesses in a country, the better it can progress towards the SDGs. These results agree with Zhou and Li (2022), who examine the role of electricity production from water sources in SDG achievement. The study implies that, in countries where power plants use water to generate electricity, both for domestic and commercial use, renewable energy is preferred. The resulting environmental quality improvement and well-being of the people add to sustainable business development.

The study outcomes indicate that electricity production from solar sources positively influences SDGs. This result is in line with the finding of Dogmus and Nielsen (2020) that, because of the greenhouse effect, the heat at the surface of the earth is increasing, affecting weather patterns, environmental quality, and human well-being. Increasing electricity output from solar sources contributes less to this heat, and improves the quality of resources, human well-being, and economic development, increasing the success of SDG achievement. These results agree with Adenle (2020), who implies that people have large supplies of renewable energy if they have solar energy sources or electricity from solar energy systems. There is energy transition and less inclination to use carbon-containing energy. This reduces energy costs to the economy, removes health issues, and preserves the environment, which are included in the SDGs.

The results reveal that industrialization from water sources positively influences SDGs, confirmed with the study of Eisenmenger et al. (2020) which sheds light on the role of industrialization in the progress towards SDGs. The study reports that industrialization increases the awareness of people regarding technologies and sources of affordable, comfortable, and clean energy in far-off areas where people rely on coal, oil, gas, wood, and dung cake. Thus, there is a reduction in greenhouse gases and heat emissions. Economic opportunities, a stable climate, a clean atmosphere, human health, and social well-being are all SDGs that can be achieved. These results agree with Fukuda-Parr and Muchhala (2020), who state that industrialization in rural areas boosts economic expansion, brings innovation to a country, increases employment opportunities, and creates equal developmental opportunities. Hence, there is progress on SDGs.

## 6. CONCLUSION

The aim of the study is to examine the relationship between carbon finance, government governance, green behaviour and awareness, electricity production from water and solar sources, and SDG achievement. It also analyses the impact of industrialization on SDG achievement. Data on carbon finance, government governance, green behaviour and awareness, electricity production from water and solar sources, industrialization, and SDGs are collected from the E7

economies. The results show that carbon finance, government governance, green behaviour and awareness, electricity production from water and solar sources, and industrialization have a positive association with SDG achievement. The results stated that, when carbon finances are granted in an economy, there is investment in eco-friendly programmes. Protection of the environment and resources accelerates economic performance, enhances employment levels, and sustains country development and human well-being, which are part of the UN SDGs. The results show that, when a government with appropriate policies governs its people, it can prevent environmental and social issues and make way for people and businesses to achieve SDGs. The results reveal that green behaviour and awareness by people improves economic and household practices and assures environmental performance, which assists in achieving SDGs. The results also reveal that electricity production from water and solar sources, with the security of environmental quality, leads to the achievement of SDGs. Moreover, industrialization gives rise to environmental and social awareness and technological development, so it leads to progress on the SDGs.

## 7. IMPLICATIONS

This study provides guidelines for academics interested in the subject of SDG achievement. It examines the relationship between carbon finance, government governance, green behaviour and awareness, electricity production from water and solar sources, industrialization, and SDG achievement. Past studies deal with the relationship between simple electricity production and SDG achievement, while the current study extends the literature through its analysis of electricity production from water and solar sources individually, in order to ascertain their role in SDG achievement. The study adds to the literature concerning the relationships among carbon finance, government governance, green behaviour and awareness, electricity production from water and solar sources, industrialization, and SDG achievement in the E7 countries.

The study has crucial importance for developing countries. It asserts a common interest of sustainable development and presents guidelines on how to attain SDGs. The study gives guidance that carbon finance should be circulated in the economy and that businesses and individuals benefitting from carbon finance enable the economy to achieve SDGs. The study finds that governments should formulate and implement policies to regulate the actions of people so that SDGs can be achieved. It suggests that the public must be taught green behaviour and awareness, as a way to achieve the SDGs. It further suggests that electricity production should be established and managed to produce energy from water so that an environment can created in which to achieve SDGs. The research guides policymakers in establishing policies related to achieving SDGs using carbon finance, effective government governance, and green behaviour and awareness. Likewise, the study implies that governments must develop policies for the production of electricity from solar sources in order to achieve SDGs. Finally, the study provide comment that governments and economists must produce industrialization over larger areas so that the economy can progress and achieve the SDGs.

## 8. LIMITATIONS

There are still some limitations to this study, which authors should address in future work. The authors are concerned only with the influences of carbon finance, government governance, green behaviour and awareness, and electricity production from water and solar sources on SDG achievement. These are other factors that should also be analysed to make progress on SDGs in future work. Moreover, this study is based on data from the E7 countries only, so there may be a question of study validity, and future authors should conduct research over a greater area.

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