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The role of human capital and environmental protection on the sustainable development goals: new evidences from Chinese economy

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ABSTRACT

Currently, the achievement of sustainable development goals (SDG) is the requirement of the entire globe and needs the attention of recent researchers and regulators. Thus, the current research also investigates the impact of human capital and environmental protection on the SDG of the developed economy like China. The researchers have explored the secondary data sources and collected the data from 1986 to 2019, and used the world development indicators (WDI) for this purpose. The current article also used the augmented dickey-fuller test (ADF) to check the stationarity and autoregressive distributed lag model (ARDL) to test the nexus among variables. The results indicated that all the predictors such as human capital index (human capital), renewable energy consumption and renewable energy production (environmental protection) have a negative association with carbon emission and a positive association with SDG. The outcomes also indicated that control variables such as economic growth and population growth have a positive association with carbon emission. These outcomes provide the guidelines to the regulators while developing policies related to sustainable development goals.

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KEYWORDS
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1. Introduction

The country's environment is significant both to society and the economy. Environmental quality influences the health of all living beings (Akram et al., 2020). A county with a good quality environment such as clean air, land, and water have good quality natural resources and healthy living beings. People who are healthy can communicate with one another pleasantly and go about their daily tasks with vigour (Elgaddafi et al., 2021). There are many economic activities that depend on natural resources and healthy people to run properly, therefore a healthy environment assures that the economy will expand quickly. Particulates, on the other hand, have an effect on the quality of the environment. Many factors are contributing to an increase in atmospheric carbon dioxide (CO2) emissions (Talha et al., 2021).

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There are two primary sources of atmospheric CO2: natural and human-made (T.-L. Chen et al., 2020). Natural CO2 emissions include human respiration, decomposition of plants and animals, and increasing ocean levels. human activities such as deforestation, cement production, and chemical manufacturing all contribute to global warming by emitting carbon dioxide into the atmosphere (Antunes & Pinheiro, 2020). Natural sources of CO2 emissions have been in operation for thousands of years before human activities had an impact on the amount of CO2 released into the atmosphere. But these are the human resources, though they are far less than the natural resources which disturb the balance of CO2 in the air (Silva et al., 2020; Tsalis et al., 2020).

The exponential increase of economic expansion has wreaked havoc on the environment and natural resources around the planet. Simultaneously, participation in social action to improve the situation is quite limited (Valencia, 2020).

Many researchers and scholars have paid attention to the impact of human capital and human choices of energy resources for environmental protection on resource preservation and sustainable development (Bali Swain & Yang-Wallentin, 2020; Fatimah et al., 2020). As the attention to social responsibility and environmental performance is increasing, firms themselves have set goals except for mere financial profit, like a commitment to environmental and social outcomes (Opoku, 2019; Wang et al., 2020). 169 goals and 17 sustainable development goals (SDGs) were endorsed by the United Nations General Assembly in 2015 as part of 'the 2030 Agenda for Sustainable Development'. As outlined in the Millennium Development Goals (MDGs), these objectives aim to close the achievement gap. As stated by Chams and Garca-Blandón in 2019, the 17 objectives are divided into three categories: social, economic, and environmental sustainability. The five Ps, or 'planet, people, peace, prosperity, and partnership', are the foundation of the organisation. The Sustainable Development Goals (SDGs) aim to accommodate and establish certain circumstances that encourage sustainable development, effective resource allocation, collective prosperity, and healthy working environments in the domains of 'people' and 'prosperity'. 'People' The ultimate objective of sustainable development goals, from a business standpoint, is to create 'people-oriented sustainable, and innovative' economies that boost employment prospects, particularly for young people (Ceko, 2021). The organization must make sure that the human resources they are applying are healthy, talented, and well-educated. Moreover, they make the effective choice of energy resources to protect the environment from pollutants like CO2 emissions. In this way, individuals and organizations, whether they are private or public sector, governmental or philanthropic organizations, can control the pollution spreading (Ilyas et al., 2020; Vörösmarty et al., 2018).

The achievement of SDG is the requirement of the entire globe and needs the attention of recent researchers and regulators. Thus, the focus of our study is the role of human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth sustainable development goals for the economy of China, one of the largest countries by area and population (Paes Paes de Faria et al., 2020). China is a newly industrialized developing country with an upper-middle-income economy. According to the

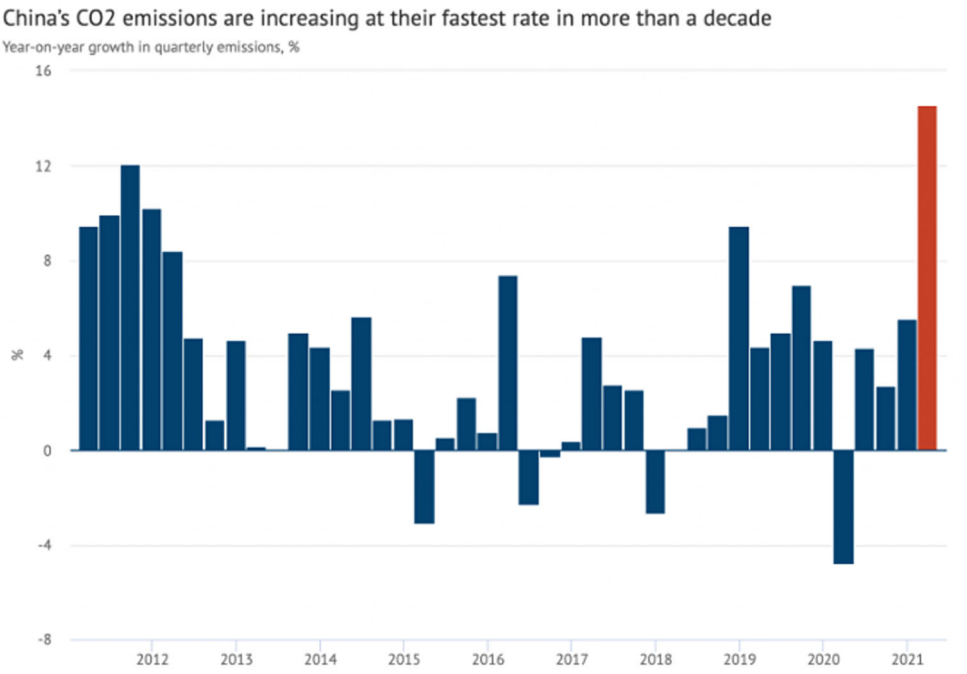

Figure 1. Carbon emission in China from 2012 to 2021.
Source: own work.

nominal gross domestic product GDP, china is the 2nd largest country across the world, while as per purchasing power parity, it is the 1st largest country (Li et al., 2018). The estimated nominal GDP is $16.642 trillion in 2021, which shows an 8.5% GDP growth rate. The economy of China is comprised of three sectors agriculture, industry, and service, with a share in the country's GDP for 7.9%, 40.5% and 51.6%, respectively. In terms of environmental quality, the agricultural industry has a negligible impact, although it does benefit the atmosphere and wildlife. However, the industrial and service sectors, which consume a lot of energy, resources, technology, and various processes, contribute to a rise in greenhouse gas emissions such as CO2 emissions (Mohsin et al., 2020). The country's population is expected to reach 1,443,995,000 by the year 2021, according to official figures. The country's pollution problem is exacerbated by the country's rapid pace of rise in pollution. Increased productivity and employment due to the country's rapidly expanding population also contributes to the country's rising CO2 emissions. This increasing trend in carbon emission is shown in Figure 1:

More amount of CO2 is released by China than in any other county. It leads many to think it is most responsible for climate change. Well, the situation is as simple as it seems. Many think that China is the biggest destroyer of the earth plant (Hannan et al., 2020; Weimin et al., 2021). In terms of pollution, it is the worst country. China has been at the top of the annual list of the world's biggest emitters of a greenhouse gas like CO2 since 2008. China releases 7.1 tons of CO2 per capita, which put the country in 48th place across the world. According to the per capita emission of CO2, China is far less than the US, which releases 16 tons of CO2 per capita and

thus, has 14th place in the list of largest CO2 emitters (Delabre et al., 2020; Rehman et al., 2021). According to the statistics of 2019, China released 10.2 billion metric tons of CO2, about twice as much as the US (5.3 billion metric tons), accounting for nearly 28% of world emissions. In terms of greenhouse gas emissions, China is the top emitter in the world, according to these figures. Because it has a negative impact on the quality and quantity of natural resources and human health, rising CO2 emissions threaten the country's ability to maintain long-term economic and social progress. As a result, this is a critical problem that requires attention and good management.

So, our study aims to overcome this social and economic problem of China by diverting the attention of the readers towards the attainment of sustainable development goals presented by the US General Assembly in the 2030 agenda. Our study aims to analyze the influences of human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth on the achievement of sustainable development goals. Many researchers from the field of economy, society, and environmental regulations have put attention on the predictors of sustainable development goals. Many have discussed the influences of human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth on sustainable development goals. But, they have been discussed in different literary workouts. Like the study of Lim et al. (2018) analyzes the influences of human resource management on sustainable development goals but ignores the factor of energy resources in this regard. But shows a recommendation for future authors to explore the role of energy resources in the achievement of sustainable development goals. Since the vacuum in literature has been filled by our research, this is a substantial addition to literature. There are several studies that focus on the significance of energy resources in achieving sustainable development objectives, but none of these studies considers the importance of human capital. As a result, this research stands out among the others. The research further contributes to the literature by examining both renewable energy use and renewable energy production for environmental preservation. Furthermore, the investigation of the human capital, environmental preservation via renewable energy consumption and production as well as the development of China's economy is a literary contribution.

The current paper is comprised of several parts. After the first part, which describes what the study is about, the second presents the hypotheses about the role of human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth in sustainable development goals with the help of past literary arguments. Then, the paper describes the processes by which data is acquired and analyzed for the ultimate results of the study about human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth and sustainable development goals. In the fourth part, the study results are supported by the previous studies. Then, study implications and conclusions are given.

2. Literature review

An increase in human domestic activities and an increase in the expansion of the business world have caused destructive influences on the environment and natural resources around the planet. And on the other hand, the social efforts undertaken for the improvement in the situation are not enough. The consistent environmental pollution might reduce or, unfortunately, finish the natural resources for the future generation. Having a sense of this threat, many individuals, organizations, and states have tried to set goals that must be attained to maintain the economic development and social well-being of people (Xu et al., 2021). A set of such goals, which was presented by the UN General Assembly, is known as sustainable development goals. But, the achievement of these sustainable development goals is determined by many economic or human, geographical factors like environment protection processes, human capital, or some other factors such as economic growth and population growth. The influences of human capital, environmental protection through renewable energy consumption and renewable energy production, economic growth, and population growth on sustainable development goals have long been discussed by many authors. Our study presents some of these arguments to present its concepts about the association among the aforementioned factors and sustainable development goals.

The value of a worker's experience and talents is referred to as human capital. To put it another way: The assets in human capital include the knowledge, education training wisdom talents skills creativity and judgement and some of the employer's values such as loyalty and regularity. Human resources who are responsible for carrying out economic operations in various domains and organisational divisions must be efficient enough to limit the quantity of CO2 emission. In order for them to be effective, they must be well-versed in methods for reducing the emission of greenhouse gases like CO2 while maintaining the quantity and quality of the businesses' goods and services. Empirical research by Zafar et al. (2019) investigates the impact of natural resources, human capital, and foreign direct investment on the ecological friendly development in the presence of economic growth and energy usage for the economy of the United States. The data were collected for the period of 1970–2015. Zivot-Andrews unit root method was used to check characteristics of data, and Auto Regressive Distributive Lag (ARDL) model was employed for estimation of long-time and short-time elasticity among the constructs (Liu & Faye, 2021). The study states that in the country which has a large human capital index indicating the availability of healthy, well-educated, and skilled workers, there is less amount of Carbon emission and are more chances for achieving sustainable development, which mostly depends on the environmental performance of the economy. The study of De Guimarães et al. (2020) analyzes the role of human capital in getting the sustainable development goal like the quality of life. The study is taken as quantitative research whose data were acquired through a survey conducted to 829 citizens in the Northeast of Brazil. Multinational data techniques with Structural Equation Modeling methodology were used for the analysis of data. The study describes that when the human resources have an awareness of the environment needs, knowledge of the eco-friendly technology or resources, the experience to handle environmental issues, and skills to apply eco-friendly procedures, technology, or resources, it is more likely for

the organization to apply ecological friendly policies, reduces the CO2 emission and improves the quality of products and services.

Environmental protection covers a major portion of Sustainable development goals as it assures an excellent quality work environment, a healthy labor force, and natural resources both for present and future use. And environmental protection also improves the social well-being of the country along with sustainable economic development (Dube & Nhamo, 2021). The natural ecological environment may be safeguarded by making wise decisions about how to satisfy one's energy needs at home and at work. Renewable energy is good for the environment since it doesn't use any fossil fuels. Biomass, biofuel, solar power, wind power, hydropower, and tidal power are all examples of renewable energy (Valencia, 2020). A rise in greenhouse gas emissions, for example, is not a side effect of using renewable energy for commercial or home reasons. Natural resources that are utilised by people to meet their fundamental requirements or supply high-quality resources for commercial entities are protected by this practise. Protecting the environment through using renewable energy sources, therefore, aids the achievement of long-term development objectives. (Momodu). The study of Vidadili et al. (2017), investigates the environmental protection through renewable energy consumption and checks their influences on sustainable development goals for the economy of Azerbaijan (Vermeulen et al., 2020). The study implies that the organizations where there is a tendency to utilize renewable energy resources like biomass, biofuel, or solar energy, for undertaking different technologies, production plants, or logistics do not become a cause of CO2 emission into the atmosphere. Thus, the organization provides a healthy environment and natural resources to the general public (Talha et al., 2021). Literary research by Xue et al. (2018), analyzes the relationship between environmental protection and sustainable development goals. This study analyzes the environmental protection sources such as green information, energy-efficient technology, renewable energy resources, and green finance and concludes that the effective implementation of environmental protection practices is helpful in achieving sustainable development goals because, in this way, CO2 can be reduced (Usman & Rozar, 2021).

Sustainable development, environmental preservation, and the use of renewable energy are all discussed in depth in an academic study by Di Baldassarre et al. According to the findings of the research, the sustainable development objectives are aimed at improving the well-being of individuals and their sense of belonging in society. When businesses opt to utilise renewable energy in their manufacturing processes, there are no hazardous wastes, poisonous gases like CO2, and ecologically beneficial goods that do not hurt the user or general public. A healthy environment, low-cost goods, and conservation of natural resources are all benefits of this policy. Thus, it leads to sustainable economic development. According to the views of Alawneh et al. (2019), it is less likely that there may be a large amount of CO2 emission in the areas where renewable energy is preferred to be produced and used (Sekerci & Yilmaz, 2021). The study highlights that the production of renewable energy like biomass energy, wind power, solar power, hydropower, and geothermal power do not release CO2 or other harmful substances into the air and thus, protect the environment and health of living beings (Yuwono et al., 2021). Moreover,

forestry, plantation, or working of solar panels minimizes the amount of CO2 from the air and during the production of renewable energy through these processes, the heat from the sun is utilized, which minimizes global warming (Tutal & Yalcin, 2021). Thus, environmental protection processes like renewable energy production minimize CO2 emissions and help achieve sustainability goals. The study conducted by Mehmood and Mansoor (2021), analyzes the association among environmental protection processes, CO2 emission, and sustainable development goals (He & Collins, 2021). This study analyzes the influences of green finance, green HRM, and renewable energy resources as environmental protection practices (Byrka-Kita et al., 2020). The study results show a significant positive impact of green finance, green HRM, and renewable energy and the achievement of sustainable development goals as they reduce the CO2 emission into the air.

Human capital and environmental protection sources like renewable energy consumption and renewable energy production are effective instruments for coping with environmental issues like CO2 emission, but population growth and economic growth of the country also have an impact on the country's ability to overcome CO2 emissions and achieve sustainable economic development. T.-L. Chen et al. (2020) studies the impact of economic growth on sustainable development, which includes the firm's social, environmental, and financial performance. Increasing employment, higher productivity, greater transportation activity, and a more extensive communication network are all associated with increased economic activity and development in a nation, according to the research (Yas et al., 2020). These all activities means more use of technologies, harmful energy and other resources, which cause the release of CO2 into the air and are a threat to the achievement of sustainable development goals. At the same time, the study of Chen et al. (2020) shows a positive influence of economic growth on the achievement of sustainable economic development. Fayed & Ezzat the study states that when a country makes rapid economic growth with a consistent rate, a moment comes when the economy develops an ability to overcome the CO2 emission and achieve sustainable development goals such as reducing poverty, zero hunger, good health and well-being, clean sanitation, innovations, affordable clean energy, and healthy & skilled workforce etc. Similarly, the increased population also affect the CO2 emission and sustainable development goals in two ways. An investigation on the effects of population increase on environmental quality and long-term economic development was carried out by Caido. It is possible that an increase in population could lead to an increase in CO2 emissions, because living organisms are the primary source of CO2 emissions, and with an increase in population comes an increase in the number of people engaging in activities that emit CO2 or related gases (Muller, 2020). As a consequence, they act as a roadblock to long-term economic growth. A research conducted by Renzaho shows that an increase in well-educated workers is positive for the economy. In the first place, they don't contribute to the emission of CO2 and don't provide a barrier to achieving long-term development objectives (Niziołek, 2021). Second, they put efforts and physical energy to control the pollution spreading and giving the general public a high standard of living.

3. Research methodology

The researchers investigate the impact of human capital and environmental protection on the SDG of the developed economy like China. The researchers have explored the secondary data sources and collected the data from 1986 to 2019, and used the WDI for this purpose. The equation for the study is given as under:

$$CO2_t = \alpha_0 + \beta_1 HCI_t + \beta_2 REP_t + \beta_3 REC_t + \beta_4 EG_t + \beta_5 PG_t + e_t \quad (1)$$

Where;

CO2 = Carbon Emission
t = Time Period
HCI = Human Capital Index
REC = Renewable Energy Consumption
REP = Renewable Energy Production
EG = Economic Growth
PG = Population Growth

The researchers used the sustainable development goals as the predictive variable and measured carbon dioxide damages (% of GNI). In addition, the researchers also used two predictors, such as human capital that measured as the human capital index and environmental protection that measured as the renewable electricity output (% of total electricity output) and Renewable energy consumption (% of total energy consumption). Finally, the study also used two control variables, such as economic growth measured as the GDP Growth (annual %) along with population growth measured as the population growth (annual %). Table 1 shows the measurements.

Firstly, the study shows descriptive statistics about the variables that show the mean, median, and standard deviation. It also shows the observations of the study along with minimum and maximum values. Secondly, this study shows the correlation matrix that shows the relations among the variables. It shows the directions of the link but not shows the significance of the relationships. Thirdly, the study shows the ADF test to examine the stationarity of the variables that are necessary to apply the suitable model. The equation for the ADF test is given as under:

$$d(Y_t) = \alpha_0 + \beta t + \mathrm{Y} Y_{t-1} + d(Y_t(-1)) + \mathfrak{E}_t \quad (2)$$

Thus, the stationarity of the constructs have been examined individually, and equations for individual ADF are mentioned below:

Table 1. Variables with measurements.

S#	Variables	Measurement	Sources
01	Sustainable Development Goals	Carbon dioxide damages (% of GNI)	World Bank Database
02	Human Capital	Human capital index	World Bank Database
03	Environmental protection	Renewable electricity output (% of total electricity output)	World Bank Database
		Renewable energy consumption (% of total energy consumption)	World Bank Database
04	Economic Growth	GDP growth (annual %)	World Bank Database
05	Population Growth	Population growth (annual %)	World Bank Database

Source: own work.

$$d(CO2_t) = \alpha_0 + \beta t + \mathrm{Y}C2_{t-1} + d(CO2_t(-1)) + \mathcal{E}_t \tag{3}$$

$$d(HCI_t) = \alpha_0 + \beta t + \mathrm{Y}HCI_{t-1} + d(HCI_t(-1)) + \mathcal{E}_t \tag{4}$$

$$d(REP_t) = \alpha_0 + \beta t + \mathrm{Y}REP_{t-1} + d(REP_t(-1)) + \mathcal{E}_t \tag{5}$$

$$d(REC_t) = \alpha_0 + \beta t + \mathrm{Y}REC_{t-1} + d(REC_t(-1)) + \mathcal{E}_t \tag{6}$$

$$d(EG_t) = \alpha_0 + \beta t + \mathrm{Y}EG_{t-1} + d(EG_t(-1)) + \mathcal{E}_t \tag{7}$$

$$d(PG_t) = \alpha_0 + \beta t + \mathrm{Y}PG_{t-1} + d(PG_t(-1)) + \mathcal{E}_t \tag{8}$$

The researchers have adopted the ARDL model to examine the relationships between the constructs. In addition, the researchers also examined the co-integration among constructs using the ARDL bond test. The estimation equation is given below:

$$\begin{aligned}\Delta CO2_t = {} & \alpha_0 + \sum \delta_1 \Delta CO2_{t-1} + \sum \delta_2 \Delta HCI_{t-1} + \sum \delta_3 \Delta REP_{t-1} + \sum \delta_4 \Delta REC_{t-1} \\ & + \sum \delta_5 \Delta EG_{t-1} + \sum \delta_6 \Delta PG_{t-1} + \varphi_1 CO2_{t-1} + \varphi_2 HCI_{t-1} + \varphi_3 REP_{t-1} \\ & + \varphi_4 REC_{t-1} + \varphi_5 EG_{t-1} + \varphi_6 PG_{t-1} + \mathcal{E}_1\end{aligned} \tag{9}$$

The researchers also examined the short-run nexus among the constructs and used the error correction model (ECM) for this purpose, and the equation for the model is given as under:

$$\begin{aligned}\Delta CO2_t = {} & \alpha_0 + \sum \delta_1 \Delta CO2_{t-1} + \sum \varphi_2 \Delta HCI_{t-1} + \sum \rightarrow_3 \Delta REP_{t-1} + \sum \theta_4 \Delta REC_{t-1} \\ & + \sum \mathrm{Y}_5 \Delta EG_{t-1} + \sum ¥_6 \Delta PG_{t-1} + \delta ECM_t + \upsilon_t\end{aligned} \tag{10}$$

4. Findings

Firstly, the study shows descriptive statistics about the variables that show the mean, median, and standard deviation. It also shows the observations of the study along with minimum and maximum values. The figures highlighted that the average value of CO2 is 3.045 while the mean value of REC is 0.343. In addition, the average value of REP is 0.457, and the mean value of HCI is 95.388. Finally, the average value of EG is 1.534, and the mean value of PG is 0.857. These figures are mentioned in Table 2.

Secondly, this research provides a correlation matrix that illustrates the relationships between the variables. The link's directions are shown, but the connections' importance is not. HCI, REC, and REP exhibit a negative correlation with CO2,

Table 2. Descriptive statistics.

	CO2	REC	REP	HCI	EG	PG
Mean	3.044851	0.343262	0.45656	95.388094	1.534159	0.856974
Median	2.887024	0.353821	0.49797	95.552127	1.283500	0.789053
Maximum	7.994729	0.416746	0.93190	112.69343	3.404000	1.815535
Minimum	0.900425	0.247523	0.21518	90.074992	0.489000	0.283427
Std. Dev.	2.211252	0.051303	6.088519	3.691191	0.876745	0.446397
Skewness	0.120701	−0.301081	0.310247	0.501353	0.621223	0.696001
Kurtosis	2.204012	1.780646	1.923810	2.686325	1.977747	2.525414
Observations	34	34	34	34	34	34

Source: own work.

Table 3. Correlation matrix.

Variables	CO2	HCI	REP	REC	EG	PG
CO2	1.000					
HCI	−0.463	1.000				
REP	−0.347	−0.213	1.000			
REC	−0.098	−0.197	−0.654	1.000		
EG	0.298	0.459	0.029	−0.644	1.000	
PG	0.415	0.514	−0.386	−0.389	0.811	1.000

Source: own work.

Table 4. Unit root test.

Augmented Dickey-Fuller Test (ADF)	Level	t-statistics	p-values
CO2	I(0)	−3.2786	0.0242
PG	I(1)	−4.7916	0.0008
HCI	I(0)	−3.8976	0.0053
REP	I(1)	−4.4636	0.0011
EG	I(1)	−6.2110	0.0000
REC	I(1)	−3.6621	0.0088

Source: own work.

according to the statistics. In addition, the findings showed that EG and PG are positively associated with CO2. Table 3 provides this information.

Thirdly, the study shows the ADF test to examine the stationarity of the variables that are necessary to apply the suitable model. The figures indicated that CO2 and HCI are stationary at level, but REP, EG, PG and REC are stationary at first difference. Thus, when some variables are stationary at the level, and some variables are stationary at the first difference, then the ARDL model is appropriate. Table 4 shows these figures.

Fourthly, to apply the ARDL model, it is necessary that the co-integration exist in the model, and ARDL bound test was used to examine the co-integration. The results show that calculated f-statistics (3.58) is higher than the critical values at the 'five per cent level of significance'. The results indicated that co-integration exist in the model. Table 5 shows the ARDL bound test results.

The present study has sued the ECM to test the short run nexus among constructs. The results indicated that all the predictors such as human capital index (human capital), renewable energy consumption and renewable energy production (environmental protection) have a negative association with carbon emission and a positive association with SDG. However, the outcomes also indicated that control variables such as economic growth and population growth have a positive association with carbon emission and a negative association with SDG. In addition, 0.657 R square value

Table 5. ARDL bound test.

				Bound test critical values	
Model	F-statistics	Lag	Level of Significance	I(0)	I(1)
CO2/(HCI, REP, REC, EG, PG)	3.58	5	1%	3.05	4.14
			5%	2.38	3.39
			10%	2.07	3.01

Source: own work.

Table 6. Short run coefficients.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HCI)	−0.449860	0.150242	−2.994236	0.0310
D(REP)	−0.666452	0.131029	−5.086293	0.0003
D(REC)	−8.270120	3.039107	−2.721233	0.0448
D(EG)	0.170552	0.028634	5.956276	0.0001
D(PG)	0.248417	0.109378	2.271179	0.0495
CointEq(−1)	−1.274823	0.223171	−5.712315	0.0004
R-squared	0.656651	Mean dependent var		−0.060852
Adjusted R-squared	0.645255	S.D. dependent var		2.125322

Source: own work.

Table 7. Long term coefficients.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HCI	−0.267931	0.127389	−2.103251	0.0421
REP	−0.668623	0.229853	−2.908916	0.0022
REC	−0.195651	0.021687	−9.021579	0.0000
EG	1.292038	0.823211	1.569510	0.1509
PG	2.098701	0.918230	2.285594	0.0312
C	0.845174	0.328095	2.576004	0.0049

Source: own work.

indicated that 65.7 per cent of variations in the SDG are due to all predictors and control variables used by the researchers. Table 6 shows the ECM results.

For the last part of this investigation, the ARDL model was used to examine the relationship between constructs in the form of a log run. Human capital index, renewable energy consumption, and renewable energy production were all shown to have a negative correlation with carbon emissions and a positive correlation with the Sustainable Development Goals, according to the findings. Economic and population growth, on the other hand, were shown to have a positive correlation with carbon emissions and a negative correlation with Sustainable Development Goals (SDG). The ARDL model findings are shown in Table 7.

5. Discussion and implications

The study results have revealed that the human capital index is in a positive association with sustainable development goals. These results are supported by the previous study of Popkova and Sergi (2020) which states that in the countries where the human capital index is high, there are minimum chances of carbon emission and the ability to gain sustainable development goals. The reason behind this is that the proficient workers who have good health, sound mind, enough knowledge about the essentials of the relevant field, and several cognitive and physical skills can better

understand the issues in the way of sustainability development like carbon emission and the ways how these issues can be overcome. Moyer and Hedden's research on the influence of human capital on sustainable development is consistent with these findings (Mosala & Chinomona, 2020). The results of the research show that having access to people in excellent health, with a high level of education and training, as well as appropriate work and life experience and abilities, may be helpful in figuring out the root causes of CO2 emissions and devising solutions to the issue. Achieving sustainable development objectives can only be done via human capital. It seems that environmental conservation and the use of renewable energy sources go hand in hand with the pursuit of long-term well-being. According to the findings of Büyüközkan, renewable energy consumption is a clean source of energy since it does not generate chemicals, greenhouse gas like CO2 and toxic wastes. It is thus beneficial to achieve sustainable development objectives such as a high-quality workplace, a healthy and productive work force, high productivity, and a high level of employment and social well-being. In accordance with Omisore's research, these findings, which indicates that with the renewable energy consumption to run technologies, logistics or performing production does not produce pollutants like CO2 emission and assists to provide a healthy work environment to the workers which do not affect their health and damage their abilities which is one of the sustainable development goals.

The results of the study have revealed that the environment protection process renewable energy production is in a positive association with sustainable development goals. These results are supported by the past study of Alcamo (2019), which implies that the production of renewable energy sources in comparison to the non-renewable energy source like a nuclear reaction does not emit harmful gases like radioactive waves, SO2, or CO2. This is a safe way to produce energy, protects the quality of the atmosphere, natural resources, and health of living beings. This ensures the quality of life and guarantees the source of earnings for the general people. The study results have also shown that population growth has a significant association with sustainable development goals. These results are in line with the previous study of Axon and James (2018), which shows that though the increase in the population of the country causes an increase in the amount of CO2 emission and resist sustainable economic development if the people are trained and educated, the same may prove to be useful in getting sustainable development goals (Simberova et al., 2020). The study results have also shown that economic growth has a significant association with sustainable development goals (Wang et al., 2020). These results are in line with the past study of Antwi-Agyei et al. (2018), which indicates that to some extent the economic growth adversely affect the environment as the increase in economic activities, use of technology, and transportation causes a large amount of CO2 emission. Thus, it becomes difficult for the country to attain sustainable development. But the effective management of economic conditions, CO2 emission can be reduced, and sustainable development goals such as reducing poverty, zero hunger, good health and well-being, clean sanitation, innovations, affordable clean energy, and healthy & skilled workforce etc., can be achieved.

The current study carries both theoretical and empirical implications. This study has a great theoretical significance because of its contribution to literature (A.

Wahhab & Al-Shammari, 2021). This study analyzes the influences of human capital and environmental protection processes like renewable energy consumption and renewable energy production along with economic growth and population growth on CO2 emission and the achievement of sustainable development goals. A long discussion has been made among researchers about the influences of human capital, renewable energy consumption, renewable energy production, economic growth, and population growth on sustainable development goals (A. M. A. Wahhab et al., 2021). But, the role of human capital and environmental protection processes like renewable energy consumption and renewable energy production along with economic growth and population growth on the achievement of sustainable development goals have been discussed in different studies. This study provides the guidelines to the regulators while developing policies related to sustainable development goals (Pécora et al., 2021). Thus, our research is a substantial contribution to the field. Renewable energy consumption has received the majority of the emphasis in previous studies, while less focus has been placed on renewable energy generation. Since it examines both consumption and production, our research is an important contribution to the literature. Furthermore, the findings of this research have a significant impact on the real world (Petit & Marnewick, 2021). As a guideline for nations that are overpopulated and unable to meet their sustainable development objectives, this paper explains how to reduce CO2 emissions inside the country and yet meet those goals (Yen et al., 2021). An extensive human capital index and environmental protection activities such as renewable energy consumption and renewable energy production, efficient management of economic growth and population expansion may help minimise CO2 emissions, according to the report.

6. Conclusion and Implications

China is the populous country and is now 2nd largest emitter of CO2 emissions into the air. Both natural and human sources are the cause of CO2 emission in China. The quality of life, including health, education, and living, is still low. Though attention has been paid to sustainable development, and its goals, have been set. Still, much improvement is needed. The current study intended to address this study to give ways to remove these problems. The aim of the study was to check the influences of human capital and environmental protection processes like renewable energy consumption and renewable energy production along with economic growth and population growth on the achievement of sustainable development goals. For this purpose, the study collected empirical pieces of evidence about human capital and environmental protection processes like renewable energy consumption and renewable energy production, economic growth and population growth, CO2 emissions, and achievement of sustainable development goals from the economy of China. The results showed that the countries which have high human capital index design policies and carry economic activities in an effective manner leave a minimum impact on environmental quality and social well-being. Thus, a large amount of human capital help implements sustainable development goals. The results indicated that renewable energy consumption reduces pollution spreading like CO2, protects the environmental

quality, and assists in getting sustainable development goals. Renewable energy production is an effective way to tackle the existing CO2 in the air as renewable energy resources absorb heat or CO2 from the air. Thus, sustainable development goals can easily be achieved. The study also concluded that with the effective management of population growth and economic growth, the amount of CO2 emission could be controlled, and sustainable development goals can be achieved.

The current study has a certain number of limitations, despite the theoretical and empirical implications. These limitations boost up researchers and authors to put some extra effort to present a more comprehensive, general, and more valid study whenever they intend to replicate the concepts of this study. First of all, a broad term like sustainable development goals, which is the combination of the environmental, social, and economic prosperity of the country, has a limited description here. The impact of only two factors human capital, and environmental protection processes like renewable energy consumption and renewable energy production, along with economic growth and population growth, on the achievement of sustainable development goals, have been analyzed. Many other factors which are a significant source of social and environmental prosperity have been ignored. Consequently, the study is not as comprehensive as it must be. Future authors are recommended to pay some attention to removing limitations while replicating the study. Moreover, supportive data regarding the influences of human capital, environmental protection processes like renewable energy consumption and renewable energy production, and economic growth and population growth on the achievement of sustainable development goals have been required from china. China is a developing country which is the largest one with respect to population and area and has different atmospheric and economic conditions from those of other countries. So, the present study about the predictors of sustainable development goals must be made general with the analysis of other economies as well.

Disclosure statement

No potential conflict of interest was reported by the author.

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