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Article

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Analysis of Factors Affecting CO_2 Emissions: In the Case of Uzbekistan

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ABSTRACT

In this study, the influence of various factors on CO_2 emissions in Uzbekistan during the period 1992-2020 was studied. The study examines the effect of forest area, urban population growth, renewable energy consumption, fossil fuel energy consumption, per capita energy consumption and industrial activity on observed CO_2 emissions. Data were analyzed using multivariate linear regression, the D'Agostino skewness test, and the Anscombe-Glynn kurtosis tests. The results show that forest area has a significant negative correlation with CO_2 emissions, suggesting that increased forest cover helps reduce emissions. Urban population growth shows a positive correlation with CO_2 emissions, emphasizing the need for sustainable urbanization practices. Renewable energy consumption has been found to have a negative impact on emissions, promoting the adoption of clean energy sources. Fossil fuel energy consumption reveals a complex relationship, with different fuels contributing differently to emissions. Per capita energy consumption and industrial activity contribute significantly to emissions, requiring the adoption of energy-efficient technologies and sustainable industrial practices.

Keywords: CO_2 Emissions, Renewable Energy, Climate Change, Greenhouse Gases, Environmental, Energy Consumption, Fossil Fuels
JEL Classifications: B17, O13, O15, L6

1. INTRODUCTION

Today, the United Nations Framework Convention on Climate Change (UNFCCC) recognizes that climate change caused by increased carbon dioxide (CO_2) emissions have indeed become a major environmental problem (Nunes, 2023). Factors such as the burning of fossil fuels, deforestation, agricultural practices, and cement production can be included as the main factors contributing to the increase in atmospheric CO_2 concentration (Murgan, 2021). Efforts are underway to mitigate the negative impacts of CO_2 emissions through carbon capture and storage (CCS) technologies (Anwar et al., 2019). Methane, another potent greenhouse gas, also contributes significantly to climate change and is largely produced in agriculture (Cadman, 2019). The UNFCCC aims to stabilize the concentration of greenhouse gases in the atmosphere to prevent dangerous anthropogenic interference with the climate system. However, despite these efforts, global CO_2 emissions continue to rise, raising concerns about the effectiveness of the UNFCCC and the Kyoto Protocol in reducing emissions.

Fossil fuels, including coal, oil, and gas, dominate the energy consumption of many countries (Pambudi et al., 2023). Coal is widely used in various industries, such as electric power, cement industry, paper industry, steel industry, etc. (Wijaya et al., 2022). For example, a study in Indonesia found that coal is the main source of local electricity supply, and about 70% of coal production is used for this purpose. In addition, the consumption of fossil fuels, including coal, oil, and gas, directly affects a country's greenhouse gas emissions. Therefore, it is very important to study and develop renewable energy sources in Uzbekistan to reduce dependence on fossil fuels and mitigate environmental impacts.

As a result of the development of the world economy, energy use and CO_2 emissions are also increasing. CO_2 emissions from fossil fuel burning and cement production make up the majority of man-made emissions (Jackson et al., 2018). According to the International Energy Agency the transport sector has been identified as a significant contributor to air pollution, accounting for 40–50 percent of total pollution. Transport investment is found to contribute to increased pollution in low- and middle-income countries, with stronger effects in low-income countries (Tudor and Sova, 2023). It is important for countries to prioritize the introduction of low-carbon technologies to improve energy efficiency and reduce greenhouse gas emissions (Sharif et al., 2023a). In addition, reducing the use of coal and oil in favor of cleaner energy sources such as gas will help reduce CO_2 emissions.

Today, one of the main problems in the world is the increase in CO_2 emissions. Therefore, reducing CO_2 emissions should be a priority for all countries, including Uzbekistan, especially in the fields of transport, energy, and production. The use of private transport is increasing in Uzbekistan, and this sector is currently the largest consumer of petroleum products and the largest producer of GHG emissions.

Figure 1 shows the CO_2 emissions of several countries from 2000 to 2020. According to it, CO_2 emissions in Germany are decreasing during the selected period, that is, from 830,284.1 kilotons in 2000 to 603,350.5 kilotons in 2020. This is a decrease of 27%. Iran's CO_2 emissions have increased over the years, only slightly decreasing in recent years. It changed from 340,456.2 kilotons in 2000 to 616,561.3 kilotons in 2020. Kazakhstan's CO_2 emissions have increased from 120,151,999 kilotons in 2000 to 211,896.7 kilotons in 2020. This means an increase of 76%. CO_2 emissions in Tajikistan have increased from 2200.97 kilotons in 2000 to 9328.8 kilotons in 2020. This means an increase of 424%. We can see that CO_2 emissions in Uzbekistan have changed from 123,804.5 kilotons in 2000 to 115,577.8 kilotons in 2020, a total decrease of 7%. We can emphasize that this is the result of the correct policy implemented in the next 2 years. As you can see, CO_2 emissions in Uzbekistan have grown much slower than in other countries in the table. In fact, CO_2 emissions in Uzbekistan are lower than in 2000. This is likely due to a number of factors, including Uzbekistan's focus on developing the renewable energy sector and efforts to improve energy efficiency.

Figure 2 shows Uzbekistan's GDP (current USD) and CO_2 emissions (metric tons per capita) for 2000-2020. According to the

Figure 1: Comparison of CO_2 emission (kt) between Uzbekistan and developing countries

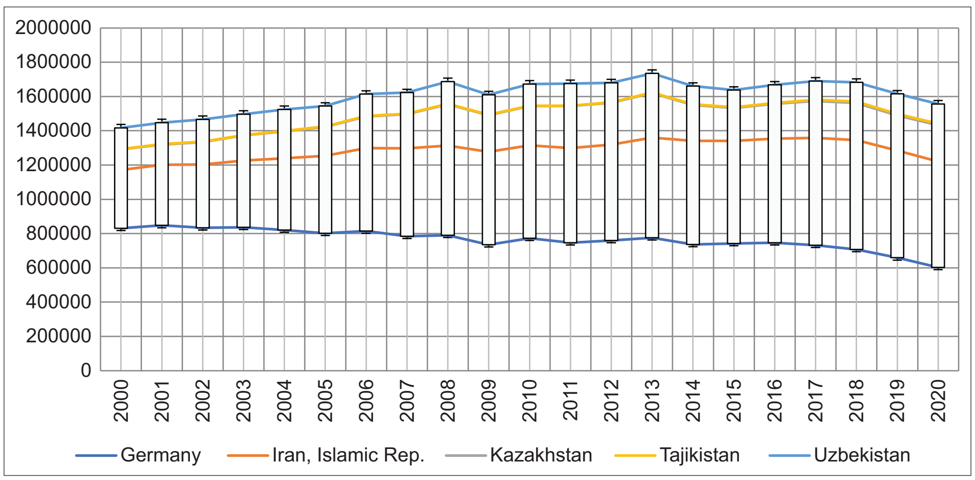
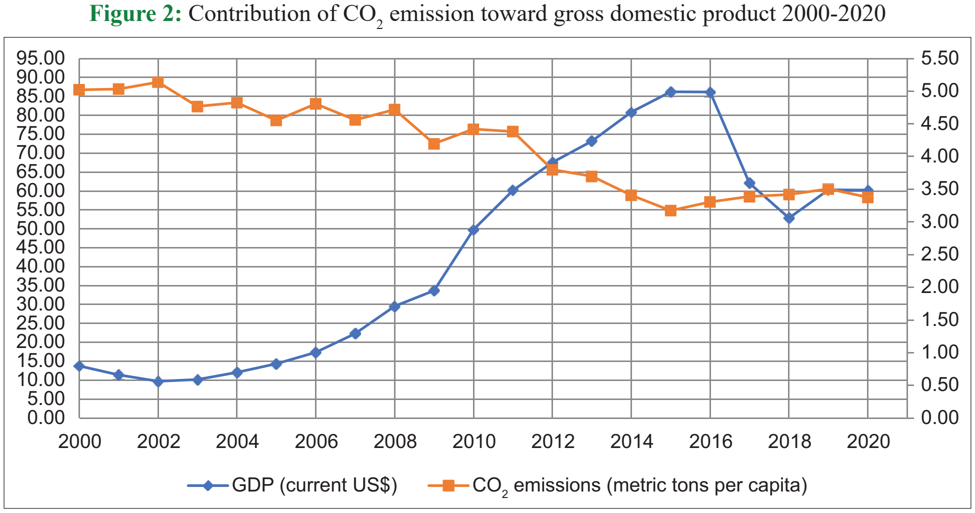


Figure 2: Contribution of CO_2 emission toward gross domestic product 2000-2020



Source: World Bank (2000-2020)

results of the analysis, GDP in Uzbekistan increased significantly from 13.76 billion dollars in 2000 to 60.22 billion dollars in 2020. This means an increase of more than 330%. We can see that CO_2 emissions have also increased over the selected period, but this increase has been slower compared to GDP. CO_2 emissions were 5.14 metric tons per capita in 2002 and then decreased to 3.38 metric tons in 2020. This represents a decrease of 34%. We can cite the following as reasons for the different trends in GDP and CO_2 emissions: We can emphasize that the economic growth of Uzbekistan was caused by factors that do not have a lot of carbon, for example, agriculture or tourism, as in other countries. Another reason is the measures taken in Uzbekistan to reduce CO_2 emissions, for example, investing in renewable energy or energy efficiency and promoting it.

2. LITERATURE REVIEW

A forest is, of course, a place where trees grow (Micalizio, 2023). Forests cover a large proportion of the world's land and play a crucial role in sequestering carbon dioxide and promoting health and well-being (Le Gear et al., 2023). Trees play a crucial role in defining the habitats of state forests (Kurowski, 2013). They provide essential elements for maintaining forest biodiversity and serve as habitats for a wide variety of species (Streszczenie, 2009). The larger the forest area, the more plants can produce oxygen and absorb CO_2 emissions. Forests play an important role in sequestering carbon, converting carbon dioxide into biomass, and releasing oxygen through photosynthesis (Wang and Cui, 2022). Forests also contribute to air and water quality and the absorption of pollutants, making them important for achieving environmental sustainability (Toledo et al., 2022). Urban forests, in particular, act as carbon sinks and help maintain the carbon-oxygen balance in cities (Li et al., 2022). In addition, studies have shown that forests play an important role in reducing CO_2 emissions globally, meaning that a 1% increase in forest area results in a 0.11% reduction in emissions (Parajuli et al., 2019). Furthermore, deforestation and degradation are major drivers of CO_2 emissions, making forest conservation important for climate change mitigation (Lundgren and Morrison-Métois, 2016).

Urbanization is the migration of the population from the countryside to the city, and the participants in this process are called urban dwellers. This movement can be attributed to various social, economic, and environmental factors, such as industrialization, job opportunities, population growth, and modernization (Humbal et al., 2023). Urbanization is causing significant social changes in developed and developing countries, with urban populations expected to account for 50 percent of the world's population by 2050 (Warwick, 2023). Urbanization is the key link between information technology, industrialization, and agricultural modernization and is crucial for sustainable economic growth and changing growth patterns (Urbanization in Developing Countries on JSTOR, n.d.). Urbanization in developing countries differs from developed countries due to various internal and external factors and has more negative effects on developing countries. Proper regulation and assistance from the government are necessary to solve the problems arising from urbanization and ensure the survival of urban dwellers.

Renewable energy consumption has a significant negative impact on CO_2 emissions. Studies have shown that increased use of renewable energy can help reduce CO_2 emissions (Mirziyoyeva and Salahodjaev, 2023). In addition, studies have found that economic growth has a mixed relationship with CO_2 emissions, with some studies suggesting an inverted U-shaped relationship while others argue for a positive relationship (Fuinhas et al., 2023). This suggests that the relationship between economic growth and CO_2 emissions is complex and may vary by country or region under study. Overall, the findings suggest that encouraging renewable energy consumption can contribute to both economic growth and CO_2 emissions reductions, potentially providing a pathway to sustainable development (Ali et al., 2023).

Many studies have found that fossil fuel energy consumption has a positive effect on economic growth (Otim et al., 2023). However, this increase in energy consumption also leads to increased CO_2 emissions, which have negative environmental consequences (Alkasasbeh et al., 2023). The use of renewable energy sources can help reduce these CO_2 emissions and thereby promote sustainable economic growth (Rao and Haq, 2023). It is necessary to phase out the concessions granted by the state for the development of traditional energy, to develop energy technologies to increase energy efficiency, and to conduct a policy of granting and supporting concessions for the use of renewable energy. In addition, in order to achieve environmental and economic sustainability, it is necessary to use alternative sources of energy consumption. The relationship between CO_2 emissions, economic growth, and energy consumption is complex, with unidirectional causality running from CO_2 emissions to economic growth and from energy consumption to CO_2 emissions.

The correlation between energy use and CO_2 emissions is positive as many studies have shown that more energy use leads to higher CO_2 emissions (Sharif et al., 2023b). This relationship is observed in many studies. Research also highlights the need to reduce the use of coal and oil, as these energy sources contribute more to CO_2 emissions than gas consumption. In addition, studies highlight the importance of transitioning to a low-carbon economy by accelerating investment in clean energy to significantly reduce CO_2 emission. It is important to note that the relationship between energy use and CO_2 emissions is bidirectional in some cases and unidirectional in others. Overall, these findings show that reducing energy consumption and switching to clean energy sources is critical to reducing CO_2 emissions and reversing environmental degradation.

The construction industry is a significant contributor to global CO_2 emissions, and reducing these emissions is critical to combating climate change. The CO_2 emission intensity of industry varies between regions, with China, India, the US, Russia, and Japan being the largest emitters among countries (Singh, 2021). The effect of the production structure and the energy intensity effect are the main drivers of differences in emission intensity between regions (Chen et al., 2021). In many countries, studies have shown that the share of industry in GDP has a positive effect on CO_2 emissions, while renewable electricity has been shown to reduce emissions (Mentel et al., 2022). The renewable energy sector mediates the positive effect of industrial value added on CO_2 emissions (Hanifa et al., 2023). The construction industry is expected to reduce CO_2 emissions by 16% by 2030 and reach zero emissions by 2050, according to the study (Construction Industry Value Chain, 2018). Research to date is exploring carbon pricing initiatives to transition to a low-carbon future in the construction sector.

3. RESEARCH METHODS

This study falls under the category of quantitative research. This study used data from 1992 to 2020 in Uzbekistan. Data source: World Bank open data. The operational definition of CO_2 emission is the gas produced by the burning of fossil fuels and accumulated in the atmosphere (CO_2 emission [kt]). A forest area is a forest area covered with trees of all types, both functional and useless (hectare) (Forest area [sq. km]); Urban population growth (annual%); renewable energy consumption (% of total final energy consumption); fossil fuel energy consumption (% of total); energy use (kg of equivalent per capita); industry (including construction); value added (current US$). Multivariate Linear Regression Data Analysis Techniques. We can mathematically express the multivariate linear regression equation as follows:

$$Et = \alpha + \beta_1*FA_{1t} + \beta_2*U_{2t} + \beta_3*REC_{3t} + \beta_4*FFC_{4t} + \beta_5*EU_{5t} + \beta_6*I_{6t} + \varepsilon \quad (1)$$

Where:
E_t = CO_2 emission
α= constant
FA = Forest Area
U =Urban pop growth
REC = Renewable energy consumption
FFC= Fossil fuel consumption
EU= Energy use
I= Industry
ε = Error term

Regression results should be the best linear unbiased estimator (BLUE, Best Linear Unbiased Estimator), which should pass classical assumptions, including multicollinearity, normality, and heteroskedasticity test.

4. RESULTS AND DISCUSSION

First of all, we need to conduct a multicollinearity test. The multicollinearity test determines whether the regression model used in the study is related to the independent (free) variables. If the VIF value is <10.00, it means that there is no multicollinearity in the regression model. In Table 1, we can see the results for all factors taken into account in the model. The results show us that there is no high multicollinearity (VIF value <10) among the selected factors (O'Brien, 2007).

The heteroskedasticity test examines whether there are differences in variance from one observation to another in a regression model. In this study, we use the Breusch-Pagan test to detect heteroskedasticity.

Through the results, we can see that there is insufficient evidence that the variance of the errors is not constant across different levels of the independent variable(s). Since the P-value in Table 2 is 0.3117006, which is greater than the usual significance level of 0.05, we cannot reject the null hypothesis. This is generally considered good because it indicates that there is insufficient evidence to conclude that heteroskedasticity exists in our regression model. In summary, a high P-value in the Breusch-Pagan test is appropriate, indicating that the assumption of constant variance is not violated and the results of our regression model can be considered more reliable.

The next step is the normality test. The normality test determines whether the data is normally distributed. In this study, we presented the results of the Shapiro-Wilk normality test, the D'Agostino skewness test, and the Anscombe-Glynn kurtosis test to check the normality. The Shapiro-Wilk normality test is used to assess whether a sample comes from a normally distributed population. This test is applied to the residuals of our regression model (Table 3). Based on the Shapiro-Wilk normality test, the results of the analysis show that there is no strong evidence that the residuals of our regression model deviate significantly from a normal distribution. This is a positive result because it supports the assumption of normality in the regression analysis.

The D'Agostino skewness test is a statistical test used to assess whether the skewness of a data set is significantly different from a normal distribution (Table 4). Since the P-value obtained from

Table 1: Multicollinearity test

S. No.	Variables	Tolerance	VIF
1	ForesArea	0.1157494	8.639355
2	Urban_pop_growth	0.4165773	2.400515
3	Renewable_energy_consumption	0.7180709	1.392620
4	Fossil_fuel_consumption	0.2484478	4.024990
5	Energy_use	0.2365653	4.227162
6	Industry	0.1653729	6.046939

Source: Output R studio

Table 2: Heteroscedasticity test

Breusch Pagan Test for Heteroskedasticity	
Ho: the variance is constant	
Ha: the variance is not constant	
Data	
Response:	CO_2_emission
Variables:	fitted values of CO_2_emission
Test	Summary
DF =	1
Chi2 =	1.023456
Prob =	0.3117006

Source: Output R studio

Table 3: Shapiro-Wilk normality test

Data: model1$residuals
W=0.96594, P=0.4554

Source: Output R studio

the analysis is 0.3829, which is greater than the usual significance level of 0.05, you cannot reject the null hypothesis. Therefore, based on the D'Agostino skewness test, we can justify that there is insufficient evidence to conclude that the data deviate significantly from a symmetric distribution.

The Anscombe-Glynn kurtosis test is a statistical test used to assess whether the kurtosis of a data set is significantly different from the kurtosis of a normal distribution (Table 5). Since the P-value obtained from the analysis is 0.8033, which is greater than the usual significance level of 0.05, you cannot reject the null hypothesis. Therefore, based on the Anscombe-Glynn kurtosis test, there is insufficient evidence to conclude that the kurtosis of your data is significantly different from 3. That is, the kurtosis does not deviate significantly from what is expected under the assumption and has a normal distribution. More simply, our data is not statistically significantly different from a normal distribution with a kurtosis of 3.

Multivariate linear regression analysis was used to measure the effect on CO2 emissions on the following variables: Forest area (ForesArea), urban population growth (Urban_pop_ growth), Renewable_energy_consumption, fuel consumption (Fossil_fuel_consumption), energy consumption (Energy_use), and industrialization (Industry) Table 6 below shows a summary of the multivariate linear regression results.

4.1. Effect of Forest Area on CO_2 Emission in Uzbekistan

The amount of forests in Uzbekistan between 1992 and 2020 significantly affects CO_2 emissions. Accordingly, the forests of Uzbekistan have the ability to absorb CO_2 emissions and generate oxygen (Worbes et al., 2006). However, the current use and management of trees and forests in Uzbekistan is insufficient (Djanibekov et al., 2012). Most tree windbreaks do not meet the criteria required for effective windbreaks (Annaeva, 2021). In addition, lack of training for farmers and gaps in forest legislation have made efforts ineffective (Butaboev and Ismanov, 2023). Despite these challenges, the Kyoto Protocol's Clean Development Mechanism (CDM) recognizes the link between reducing emissions and combating land degradation, and afforestation and reforestation projects have been promoted in agricultural countries (Botman, 2009). Therefore, with proper management and support, Uzbekistan's forests can contribute to reducing CO_2 emissions and improving oxygen production. In our analysis, we found a positive relationship between forest area and CO_2 emissions. Let's consider why deforestation in Uzbekistan leads to an increase in waste. Forests absorb and store carbon dioxide (CO_2). When deforestation occurs, the carbon stored in trees is released back into the atmosphere as CO_2, contributing to greenhouse gas emissions. Deforestation often involves changes in land use, such as clearing land for agriculture, urbanization, or other purposes. Such land-use changes can increase emissions by releasing carbon stored in vegetation and soil. In some cases, deforestation involves the deliberate burning of vegetation. Burning biomass releases significant amounts of CO_2 and other pollutants into the atmosphere. If cleared land is used for activities involving fossil fuel consumption or other emissions-intensive processes, this may contribute to the observed increase in CO_2 emissions.

Table 4: D'Agostino skewness test

Data: model1$residuals
Skew=−0.34267, z=−0.87254, P=0.3829
Alternative hypothesis: data have a skewness

Source: Output R studio

Table 5: Anscombe-Glynn kurtosis test

Data: model1$residuals
Kurt = 2.51870, z=−0.24913, P = 0.8033
Alternative hypothesis: kurtosis is not equal to 3

Source: Output R studio

4.2. The Influence of Urban population growth on CO_2 Emission in Uzbekistan

Urban population growth in Uzbekistan between 1992 and 2020 has a positive and significant impact on CO_2 emissions. The urban population in Uzbekistan is growing rapidly, this process indicates that the country is developing. The development and regulation of urbanization in Uzbekistan can contribute to sustainable socio-economic and innovative development based on the formation of the urban environment and urban lifestyle (Salimova, 2022). CO_2 emissions in cities are increasing very much, that is, CO_2 emissions vary depending on the level of development of countries, This process is increasing in developing countries (Luqman et al., 2023). Per capita urban emissions are often lower than national averages for developed countries, suggesting that urbanization can reduce overall emissions (Yassin and Aralas, 2019). It should

Table 6: Multiple linear regression results

Residuals					
Min	1Q	Median	3Q	Max	
−9058.0	−2901.5	−56.1	3270.5	6397.5	
Coefficients	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**	
(Intercept)	1.362e+06	4.924e+05	2.767	0.011242*	
ForesArea	3.784e+00	7.758e-01	4.878	7.08e-05***	
Urban_pop_growth	5.701e+03	1.985e+03	2.873	0.008839**	
Renewable_energy_consumption	-1.416e+04	3.311e+03	-4.277	0.000307***	
Fossil_fuel_consumption	-1.428e+04	5.104e+03	-2.797	0.010506*	
Energy_use	3.051e+01	9.514e+00	3.207	0.004062**	
Industry	-1.548e-06	3.360e-07	-4.606	0.000137***	

Signif. codes: 0 "***". 0.001 "**", 0.01 "*", 0.05 ".", 0.1 " " 1, Residual standard error: 4600 on 22 degrees of freedom, Multiple R-squared: 0.8171, Adjusted R-squared: 0.7673, F-statistic: 16.38 on 6 and 22 DF, P-value: 4.136e-07 be noted that the influence of urbanization on CO_2 emissions is significant in Uzbekistan, as was found in similar studies conducted in Pakistan (Ali et al., 2019), Turkey (Pata, 2018a) and other developing countries (Martinez-Zarzoso, 2008). As a result of the research analysis, we should note that urbanization increases CO_2 emissions, and this effect is especially evident in low-income countries. As Uzbekistan continues to urbanize, CO_2 emissions will continue to increase. Therefore, the country needs to choose the right policy aimed at reducing urban planning, construction, and waste in cities, and implement the experience of developed countries.

4.3. The Influence of Renewable Energy Consumption on CO_2 Emission in Uzbekistan

According to the results of the analysis, the use of renewable energy hurts CO_2 emissions in Uzbekistan. Increasing the use and development of renewable energy sources, such as solar energy, in the country will help reduce greenhouse gas emissions in the agricultural sector (Mukhtarov et al., 2022). Studies conducted by scientists have found that renewable energy consumption has a negative impact on CO_2 emissions and, at the same time, a positive impact on real GDP per capita. The results show that a 1% increase in renewable energy consumption leads to a 0.26% reduction in consumption-based CO_2 emissions, while a 1% increase in real GDP per capita leads to a 0.46% increase in consumption-based CO_2 emissions (Mukhtarov et al., 2022). Uzbekistan has great potential for renewable energy development, as we can justify the abundance of sunny days throughout the country on most days of the year, which indicates that it has a large potential for usable solar energy production (Anarbaev et al., 2019a). By developing the use of renewable energy sources, Uzbekistan can meet its national demand for electricity and heat while reducing dependence on fossil fuels, which is very important today, and reducing CO_2 emissions (Sobirov and Makhmudov, 2020). Today, in order to achieve sustainable development and mitigate climate change, Uzbekistan needs to increase the share of renewable energy sources in total energy use and implement a strict policy of implementing environmentally friendly measures ("Theoretical and Applied Science", n.d.-a). According to the research, the introduction of renewable energy technologies in agriculture, which has the potential to be developed in Uzbekistan, has led to a significant reduction in greenhouse gas emissions (Anarbaev et al., 2019b). These results are consistent with the conclusions of the analysis results of our study in Central Asia, which observed a negative effect of renewable energy consumption on CO_2 emissions. In this regard, we tried to directly consider the specific impact of renewable energy consumption on CO_2 emissions in Uzbekistan in our research.

4.4. The Influence of Fossil Fuel Energy Consumption on CO_2 Emission in Uzbekistan

Studies have found that fossil fuel energy consumption has a mixed relationship with CO_2 emissions. Studies have found that in some cases the share of coal in electricity production has a negative effect on CO_2 emissions (Yilmaz and Sensoy, 2022). However, it is safe to say that the positive effect of natural gas on CO_2 emissions is lower and less significant (Ugur et al., 2023). In addition, many studies have found that natural gas consumption has a negligible effect on CO_2 emissions compared to oil consumption, while renewable and hydropower consumption can reduce CO_2 emissions (Belbute and Pereira, 2021). On the other hand, increased oil consumption in the short or long term has been found to increase CO_2 emissions in all three major carbon emitters (Belucio et al., 2022). Therefore, the relationship between fossil fuel energy consumption and CO_2 emissions is complex and varies depending on the specific fuel and country considered. Many studies consistently show a negative relationship between fossil fuel energy consumption and CO_2 emissions. It is very important to develop a policy in this direction in Uzbekistan.

4.5. The Influence of energy use (kg of equivalent per capita) on CO_2 Emission in Uzbekistan

Energy use in Uzbekistan is positively related to CO_2 emissions. An increase in energy consumption leads to an increase in CO_2 emissions in the country (Wang et al., 2020). In our research, we found that as energy consumption (measured in kg equivalent per capita) increases, CO_2 emissions also increase in Uzbekistan. It should be noted that, as seen in similar studies conducted in Ukraine, Turkey, Pakistan, and Russia, the impact of energy use on CO_2 emissions in Uzbekistan is a complex issue. In addition, researchers have found that carbon taxes and non-carbohydrate energy consumption can significantly reduce CO_2 emissions, and we can show that such measures can be effective in Uzbekistan (Frey, 2017; Pata, 2018b). However, studies have highlighted the positive effects of industrialization and the negative effects of forest cover on CO_2 emissions, suggesting that these factors should also be taken into account in any policy intervention (Munir and Khan, 2014; Raihan and Tuspekova, 2022).

4.6. The Influence of Industry on CO_2 Emission in Uzbekistan

Between 1992 and 2020, industrialization in Uzbekistan has been found to have a negative and significant impact on CO_2 emissions. The results of our study contradict the theory that industrialization has a significant and positive effect on CO_2 emissions. Due to the increase in the cost of energy, operating costs will increase. Businesses are becoming more efficient to save costs and remain competitive. Through more efficient use of energy in industry, emissions levels and emission intensity from the industrialization sector can be significantly reduced. The industrial expansion has environmental impacts. Impacts include air pollution and environmental degradation. Atmospheric air pollution is caused by the operation of industrial production equipment, which emits smoke through factory chimneys, which are involved in more combustion activities during the production process (Peng et al., 2023).

The influence of the construction industry on CO_2 emissions in Uzbekistan is significant. Cement production, a major branch of the construction industry, is a major source of greenhouse gas emissions, particularly carbon dioxide (CO_2) emissions (Turakulov et al., 2023). Cement factories in Uzbekistan generate a large amount of CO_2 emissions, which make up 11.3% of the total emissions in the country (Uzbekistan Construction Market Size, Trend by Sector and Forecast to 2027, n.d.). The construction industry in Uzbekistan is experiencing growth due to the increase in population, which leads to an increase in the need for investment in construction (Abdukadirova, 2021). In recent years, reforms have been implemented to address the goals and objectives of the construction industry, including the strategy of the Ministry of Construction. Providing housing for the growing population is an important socio-economic task, and the use of industrial methods such as high-rise construction is proposed as a solution ("Theoretical and Applied Science", n.d.-b). The impact of industrial value added on CO_2 emissions in Uzbekistan can be understood through the lens of similar studies in the region. These studies show that a comprehensive understanding of the drivers of CO_2 emissions in Uzbekistan requires consideration of the country's industrial activities and energy sources. In general, the development of the construction industry in Uzbekistan requires the improvement of management methods, innovation, and the introduction of energy-saving technologies to reduce CO_2 emissions (Ismailov, 2023).

5. CONCLUSIONS

Today, the level of CO_2 emissions is emerging as a serious environmental problem. Global warming and rising temperatures are causing great damage to the environment. Rising greenhouse gas emissions around the world are contributing to global warming. In summary, this study provides a comprehensive analysis of factors affecting CO_2 emissions in Uzbekistan. The findings highlight the multifaceted nature of these impacts, ranging from the positive effects of increased forest cover to the challenges associated with rapid urbanization and industrial growth. Sustainable urbanization practices, together with the transition to renewable energy sources, are emerging as important strategies to limit CO_2 emissions.

The complex relationship between fossil fuel consumption and emissions requires sensitive approaches and careful consideration of the types of fuels used. In addition, the study highlights the need for energy efficiency measures and sustainable practices in the industrial sector, especially in high-emission sectors such as cement production.

Research calls for the formulation and implementation of targeted policies that encourage the adoption of environmentally friendly practices, innovation, and green technologies. As Uzbekistan continues its path of economic development, it will be critical to integrate environmental issues into national strategies to achieve a balance between growth and environmental sustainability. The information from this study will contribute to solving the ongoing challenges of climate action and provide valuable guidance for policymakers, researchers, and stakeholders invested in creating a sustainable future for Uzbekistan.

REFERENCES

Abdukadirova, M.A. (2021), The role of builder and building in the development of the country is invaluable. The American Journal of Interdisciplinary Innovations and Research, 3(5), 81-84.

Ali, A., Radulescu, M., Balsalobre-Lorente, D. (2023), A dynamic relationship between renewable energy consumption, nonrenewable energy consumption, economic growth, and carbon dioxide emissions: Evidence from Asian emerging economies. Energy and Environment, 34(8), 3529-3552.

Ali, R., Bakhsh, K., Yasin, M.A. (2019), Impact of urbanization on CO_2 emissions in emerging economy: Evidence from Pakistan. Sustainable Cities and Society, 48, 101553.

Alkasasbeh, O.M., Alassuli, A., Alzghoul, A. (2023), Energy consumption, economic growth and CO_2 emissions in Middle East. International Journal of Energy Economics and Policy, 13(1), 322-327.

Anarbaev, A., Tursunov, O., Kodirov, Di., Muzafarov, S., Babayev, A., Sanbetova, A., Batirova, L., Mirzaev, B. (2019a), Reduction of greenhouse gas emissions from renewable energy technologies in agricultural sectors of Uzbekistan. E3S Web of Conferences, 135, 01035.

Anarbaev, A., Tursunov, O., Kodirov, Di., Muzafarov, S., Babayev, A., Sanbetova, A., Batirova, L., Mirzaev, B. (2019b), Reduction of greenhouse gas emissions from renewable energy technologies in agricultural sectors of Uzbekistan. E3S Web of Conferences, 135, 01035.

Annaeva, Z. (2021), Basic principles of environmental policy of Uzbekistan. Society and Innovation, 2(9/S), 177-180.

Anwar, M.N., Iftikhar, M., Khush Bakhat, B., Sohail, N.F., Baqar, M., Yasir, A., Nizami, A.S. (2019), Sources of Carbon Dioxide and Environmental Issues. Cham: Springer. p13-36.

Belbute, J.M., Pereira, A.M. (2021), The relationship between consumption and Co_2 emissions: Evidence for Portugal. Sustainability, 13(21), 12153.

Belucio, M., Santiago, R., Fuinhas, J.A., Braun, L., Antunes, J. (2022), The impact of natural gas, oil, and renewables consumption on carbon dioxide emissions: European evidence. Energies, 15(14), 5263.

Botman, E. (2009), Forest rehabilitation in the Republic of Uzbekistan. In: Keep Asia Green. West and Central Asia, Vienna: IUFRO World Series, p253.

Butaboev, M., Ismanov, I. (2023), Uzbekistan's "Green " Econonmy Trasition Strategy and its Essence. Economy and Education, 24(1), 28-40.

Cadman, T. (2019), The United Nations framework convention on climate change. In: The Palgrave Handbook of Contemporary International Political Economy. Germany: Springer. p359-375.

Chen, J., Wang, Y., Shi, Q., Peng, X., Zheng, J. (2021), An international comparison analysis of CO_2 emissions in the construction industry. Sustainable Development, 29(4), 754-767.

Construction Industry Value Chain. (2018), Available from: https://www.academia.edu/80927712/construction_industry_value_chain_how_companies_are_using_carbon_pricing_to_address_climate_risk_and_find_new_opportunities

Djanibekov, U., Khamzina, A., Djanibekov, N., Lamers, J.P.A. (2012), How attractive are short-term CDM forestations in arid regions? The case of irrigated croplands in Uzbekistan. Forest Policy and Economics, 21, 108-117.

Frey, M. (2017), Assessing the impact of a carbon tax in Ukraine. Climate Policy, 17(3), 378-396.

Fuinhas, J.A., Koengkan, M., Filipe, R., Santiago, B., Madaleno, M., Nogueira, M.C. (2023), How renewable energy and CO_2 emissions contribute to economic growth, and sustainability-an extensive analysis. Sustainability, 15(5), 4089.

Hanifa, M., Agarwal, R., Sharma, U., Thapliyal, P.C., Singh, L.P. (2023), A review on CO_2 capture and sequestration in the construction industry: Emerging approaches and commercialised technologies. Journal of CO2 Utilization, 67, 102292.

Humbal, A., Chaudhary, N., Pathak, B. (2023), Urbanization Trends, Climate Change, and Environmental Sustainability. Singapore: Springer, 151-166.

Ismailov, A. (2023), Priority directions for the development of the economic potential of the construction industry of the Republic of Uzbekistan. Economics and Innovative Technologies, 11(1), 243-251.

Jackson, R.B., Le Quéré, C., Andrew, R.M., Canadell, J.G., Korsbakken, J.I., Liu, Z., Peters, G.P., Zheng, B. (2018), Global energy growth is outpacing decarbonization. Environmental Research Letters, 13(12), 120401.

Kurowski, J.K. (2013), Obszary Natura 2000 w Województwie ŁódzkimInstytut Ekologii i Ochrony Środowiska (Uniwersytet Łódzki), and Regionalna Dyrekcja Ochrony Środowiska (Łódź). Available from: https://www.researchgate.net/publication/312072153_ochrona_siedlisk_przyrodniczych_i_gatunkow_natura_2000_w_wojewodztwie_lodzkim_conservation_of_natural_habitats_natura_2000_in_the_lodz_province

Le Gear, K., Carlin, C., Flaherty, G.T. (2023), Deep roots: Realising the public health benefits of exposure to forest environments. Advances in Integrative Medicine, 10(2), 86-88.

Li, D., Mu, H., Gao, Y., Lu, M., Liu, C. (2022), A GIS-based analysis of the carbon-oxygen balance of urban forests in the Southern Mountainous Area of Jinan, China. Sustainability, 14(23), 16135.

Lundgren, H., Morrison-Métois, S. (2016), Forests and Sustainable Forest Management evaluation Evidence on Addressing Deforestation to Reduce CO_2 Emissions. France: OECD. Available from: https://bibliotecadigital.ciren.cl/handle/20.500.13082/26679

Luqman, M., Rayner, P.J., Gurney, K.R. (2023), On the impact of urbanisation on CO_2 emissions. NPJ Urban Sustainability, 3(1), 6.

Martinez-Zarzoso, I. (2008), The Impact of Urbanization on CO_2 Emissions: Evidence from Developing Countries. Social Science Research Network. CESIFO Working Paper, No. 2377. Munich: Center for Economic Studies and ifo Institute (CESIFO).

Mentel, U., Wolanin, E., Eshov, M., Salahodjaev, R. (2022), Industrialization and CO_2 emissions in Sub-Saharan Africa: The mitigating role of renewable electricity. Energies 15(3), 946.

Micalizio, C.S. (2023), A forest, for the trees. Eos (United States), 104(1), 1.

Mirziyoyeva, Z., Salahodjaev, R. (2023), Renewable energy, GDP and CO_2 emissions in high-globalized countries. Frontiers in Energy Research, 11, 1123269.

Mukhtarov, S., Aliyev, F., Aliyev, J., Ajayi, R. (2022), Renewable energy consumption and carbon emissions: Evidence from an oil-rich economy. Sustainability, 15(1), 134.

Munir, S., Khan, A. (2014), Impact of fossil fuel energy consumption on CO_2 emissions: Evidence from Pakistan (1980-2010). The Pakistan Development Review, 53(4), 327-346.

Murgan, M.G.A. (2021), Revisiting the role of United Nations framework convention on climate change (UNFCCC) and the Kyoto protocol in the fight against emissions from international civil aviation. Nnamdi Azikiwe University Journal of International Law and Jurisprudence, 12(1), 112-126.

Nunes, L.J.R. (2023), The rising threat of atmospheric CO_2: A review on the causes, impacts, and mitigation strategies. Environments, 10(4), 66.

O'Brien, R.M. (2007), A caution regarding rules of thumb for variance inflation factors. Quality and Quantity, 41(5), 673-690.

Otim, J., Watundu, S., Mutenyo, J., Bagire, V. (2023), Fossil fuel energy consumption, economic growth, urbanization, and carbon dioxide emissions in Kenya. International Journal of Energy Economics and Policy, 13(3), 457-468.

Pambudi, N.A., Firdaus, R.A., Rizkiana, R., Ulfa, D.K., Salsabila, M.S., Suharno, Sukatiman. (2023), Renewable energy in Indonesia: Current status, potential, and future development. Sustainability, 15(3), 2342.

Parajuli, R., Joshi, O., Maraseni, T. (2019), Incorporating forests, agriculture, and energy consumption in the framework of the environmental Kuznets curve: A dynamic panel data approach. Sustainability, 11(9), 2688.

Pata, U.K. (2018a), The effect of urbanization and industrialization on carbon emissions in Turkey: Evidence from ARDL bounds testing procedure. Environmental Science and Pollution Research International, 25(8), 7740-7747.

Pata, U.K. (2018b), The influence of coal and noncarbohydrate energy consumption on CO_2 emissions: Revisiting the environmental Kuznets curve hypothesis for Turkey. Energy, 160, 1115-1123.

Peng, Z., Zhang, Y., Wang, Y., Tang, T. (2023), Association discovery and outlier detection of air pollution emissions from industrial enterprises driven by big data. Data Intelligence, 5(2), 438-456.

Raihan, A., Tuspekova, A. (2022), Nexus between energy use, industrialization, forest area, and carbon dioxide emissions: New insights from Russia. Journal of Environmental Science and Economics, 1(4), 1-11.

Rao, G.B., Haq, A. (2023), CO_2 emissions, economic growth and energy consumption nexus: The case of India. Theoretical and Applied Economics, 63-76. https://doi.org/10.21203/RS.3.RS-2871711/V1

Salimova, Y. (2022), Development of a concept for the development and regulation of urbanization in Uzbekistan. Science and Innovation, 11, 65-67.

Sharif, F., Hussain, I., Qubtia, M. (2023a), Energy consumption, carbon emission and economic growth at aggregate and disaggregate level: A panel analysis of the top polluted countries. Sustainability, 15(4), 2935.

Sharif, F., Hussain, I., Qubtia, M. (2023b), Energy consumption, carbon emission and economic growth at aggregate and disaggregate level: A panel analysis of the top polluted countries. Sustainability, 15(4), 2935.

Singh, D. (2021), The Linkage Between CO2, FDI, Economic Growth and Value-Added: A European Perspective. https://doi.org/10.21203/RS.3.RS-170999/V1

Sobirov, Y., Makhmudov, S. (2020), Use of renewable energies in Uzbekistan. Advances in Robotics and Mechanical Engineering, 2(3), 000137.

Streszczenie, J.S. (2009), Zastosowanie narzedzi geomatycznych na przykladzie wynikow inwentaryzacji przyrodniczej w Lasach Panstwowych w 2007 roku. Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej, 11(2), 192-197.

Theoretical and Applied Science. (n.d.-a), Available from: from http://www.t-science.org/arxivDOI/2020/01-81/01-81-136.html [Last accessed on 2024 Feb 07].

Theoretical and Applied Science. (n.d.-b), Available from: http://www.t-science.org/arxivDOI/2020/02-82/02-82-74.html [Last accessed on 2024 Feb 08].

Toledo, E., Ochoa-Moreno, W.S., Alvarado, R., Cuesta, L., Murshed, M., Rehman, A. (2022), Forest area: Old and new factors that affect its dynamics. Sustainability, 14(7), 3888.

Tudor, C., Sova, R. (2023), The Impact of the Transport Sector on the Environment in the Context of Globalization. Lecture Notes in Intelligent Transportation and Infrastructure. Part F1378. Germany: Springer. p63-73.

Turakulov, Z., Kamolov, A., Turakulov, A., Norkobilov, A., Fallanza, M. (2023), Assessment of the decarbonization pathways of the cement industry in Uzbekistan. Engineering Proceedings, 37, (1), 2.

Ugur, M.S., Çatik, A.N., Sigeze, C., Balli, E. (2023), Time-varying impact of income and fossil fuel consumption on CO_2 emissions in India. Environmental Science and Pollution Research 30(58), 121960-121982.

Urbanization in Developing Countries on JSTOR. (n.d.), Available from: https://www.jstor.org/stable/3986401 Last accessed on 2024 Feb 10].

Uzbekistan Construction Market Size, Trend by Sector and Forecast to 2027. (n.d.), from https://www.globaldata.com/store/report/uzbekistan-construction-market-analysis [Last accessed on 2024 Feb 07].

Wang, F., Wang, C., Chen, J., Li, Z., Li, L. (2020), Examining the determinants of energy-related carbon emissions in Central Asia: Country-level LMDI and EKC analysis during different phases. Environment, Development and Sustainability, 22(8), 7743-7769.

Wang, Z., Cui, X. (2022), Research and Analysis of Carbon Sequestration Prediction Scheme Based on Multi-Model. In: Proceedings-2022 7th International Conference on Information and Network Technologies. p85-90.

Warwick, T. (2023), Urbanisation. Routledge Historical Resources-19th Century British Society. London: Routledge.

Wijaya, A., Awaluddin, M., Kurniawan, A.E. (2022), The essence of fuel and energy consumptions to stimulate MSMEs industries and exports: An empirical story for Indonesia. International Journal of Energy Economics and Policy, 12(2), 386-393.

Worbes, M., Botman, E., Khamzina, A., Tupitsa, A., Martius, C., Lamers Number, J.P.A., Lamers, J.P.A. (2006), Scope and constraints for tree planting in the irrigated landscapes of the Aral Sea Basin: Case studies in Khorezm Region, Uzbekistan. Germany: University of Bonn.

Yassin, J., Aralas, S.B. (2019), The urbanization effect on CO_2 emissions: New evidence of dynamic panel heterogeneity in Asian countries. International Journal of Economics and Management, 1(1), 8-18.

Yilmaz, E., Sensoy, F. (2022), Effects of fossil fuel usage in electricity production on CO_2 Emissions: A STIRPAT model application on 20 selected countries. International Journal of Energy Economics and Policy, 12(6), 224-229.