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Local Government Investments and the Safety of an Ecosystem: Mathematical Evidence from a Developing Nation

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Abstract: Local governments are the motors that drive the lives of their citizens. There is no human individual who does not live under a local government, regardless of where they are situated. This is why every local authority's environment requires a wide range of investments to make it safe and clean. In this research, we assess the expenditure arrangements of Nigerian local governments to guarantee environmental safety. A green and healthy environment is the ultimate goal of all nations throughout the world; thus, local governments are also working to reduce CO_2 pollution in their communities. Nigeria has 774 local governments, and the bulk of these areas have significant pollution densities, owing to CO_2 emissions from crude oil refining for both commercial and domestic use. The Niger Delta regions, where commercial quantities of crude are tapped, are the most affected by this predicament. The two techniques of spending (recurrent and capital) in local government are examined in this paper for the period from 1993 to 2020 using a multiple regression method to determine their influence on CO_2 emissions reduction. The results reveal that the combination of the two methods reduce the effect of CO_2 emissions, but capital spending has a greater positive benefit than recurrent spending. Examination of this link reveals that there is a very weak association between CO_2 emissions and the two types of local government expenditure. The obtained results suggest that local administrations should deploy necessary environmental statutes, fines, and penalties using security officers for enforcement in order to put a halt to illegal crude oil refining and pollution.

Keywords: local government investments; CO_2 pollution; environmental safety; green ecosystem

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1. Introduction

The role of local government fiscal investments in ensuring environmental safety through carbon reduction is critical. Carbon pollution is considered the greatest threat to the safety of a nation's ecosystem, necessitating a concerted effort on the part of government at all levels to strategically and economically engage in its reduction. Fiscal investment refers to the investing practices of central and municipal governments using monies collected through fiscal methods or produced funds [1]. According to [2], fiscal investment plays a substantial role in reducing emissions. It is the responsibility of governments at all levels to maintain the environmental security and safety of all residents, both internationally and nationally. According to [3], sustainability spending may minimize ecological damage and promote environmental conservation, in addition to having a beneficial impact on emissions reduction. CO_2 is a worldwide public good [4,5]; thus, local governments must have adequate financial clout to control its production at the local level. This is imperative to actualize real fiscal growth for a nation. Cheng et al. [6] asserted that it has become critical for tier system administrations to concentrate on the function of various levels of government in decreasing carbon footprints.

Governments have always been major players in reducing emissions of CO_2. It is worth noting that the achievement of critical environmental safety is dependent on effective

governance [7]. Thus, government spending has a significant impact on environmental conservation [8–10]. Relatively low authorities are controlled and nominated by relatively high-level administrations as a result of political dominance. The federal government grants taxing and investment authority to municipal authorities through devolution. As stated in [11], the larger the percentage of local-to-federal fiscal spending, the greater the extent of local fiscal autonomy. Previous research revealed that governmental financial investment exerts a substantial influence on decarbonization [12–14]. Some studies focus on minimizing pollution through various sorts of fiscal interventions [1]. According to [15], increasing large-scale investment in solar and wind power may successfully cut emissions and contribute to the creation of a healthy, low-carbon economy. Infrastructural development can influence greenhouse gases [16,17]. As reported in [18], ecological sustainability expenditure promotes a low-carbon economic processes and aids in emission reduction.

Nigeria's government is divided into three levels: federal, state, and local. Local authority is Nigeria's third tier of government, and its functions are outlined in the Fourth Schedule of the 1999 Constitution. As a result, under the current vertical resource distribution mechanism in Nigeria, local authority is judicially eligible to receive 20.60 percent of the money credited to the Federation Account after subtracting the Niger Delta States' 13 percent extraction allotment. According to the terms and conditions of the Federation Account Act (FAA) 2002, 1992 No. 106, and S.1.9, the 20.60 percent allotment to municipal authorities should be distributed laterally based on fairness (40 percent), inhabitants (30 percent), land area (10 percent), and domestic earnings (10 percent). According to the terms of these regulations, local governments are responsible for shouldering a specific amount of expenditures, such as for cleaning the environment, removing filth from waterways, and controlling pollution to the extent that they are capable of doing so. Nigeria has 774 local government areas (LGAs), each of which is governed by a local authority comprised of a Chairperson, who serves as the chief executive, and other members of the council known as Council Members. Each LGA is further segmented into at least 10 and as many as 20 districts. A Council Member administers a constituency and passes information to the LGA Chairperson. The Council Members are the lawmaking body of the municipal government, Nigeria's third level in the hierarchy after the federal and state governments.

This research focuses on the fiscal spending obligation of Nigeria's local authorities in minimizing the threat of pollutant emissions in all of its surroundings, including towns and villages. The main purpose of this research is to emphasize the need to employ local resources to enhance environmental pollution control in the local vicinity, which invariably requires investment in green technology and a rapid switch to renewable energy sources. Several studies on the impact of local government obligations on environmental pollution reduction have revealed both positive [19–21] and negative [7,22,23] outcomes. As a result, there is no consensus among scholars. Therefore, the aim of the present research is to provide insight on the usefulness of local resources in providing a safe ecosystem through proper investment and environmentally friendly financial strategies.

2. Literature Review

Xiao et al. [24] examined the direct and indirect influence of local government spending on CO_2 emissions from 2000 to 2008. According to their findings, the direct impact of local government spending on CO_2 emissions was notably negative. Local governments had an indirect impact on CO_2 emissions by altering the economic scale, industrial structure, and technical level of the area. The industrial structure, with secondary industry as the primary industry, has kept Chinese CO_2 emissions high, whereas the influence of local government expenditures on economic structure was minimal. The predicted coefficient of the entire effect was negative, and local government spending reduced Chinese CO_2 emissions overall. He et al. [1] used panel data from 30 Chinese cities and territories to investigate the influence of local government investment (LGI) on the decrease in carbon pollution. Their study examined the direct effect of LGI on atmospheric CO_2 reduction in 30 provinces and cities included in the research using a cointegration test, a panel data

model, and convergence analytics based on Chinese data covering the period between 2000 and 2013. The researchers grouped local governments into five groups depending on the extent to which they regulated carbon output: robust, fairly robust, moderate, largely ineffective, and vulnerable. The influence of LGI on decarbonization was large in the western and central parts of China, with less influence in the eastern and northeast areas.

Hecto and Opper [19] investigated how the effects of federal systems in China, as assessed by government budget percentages of total regional product, were connected to ecological diversity between counties, as assessed by carbon dioxide emission severity. A panel dataset of 30 Chinese provinces was systematically explored for the period between 2003 and 2015 using the fixed-effect technique. The findings of the tests demonstrated that provinces with a high revenue-to-capital ratio had greater greenhouse gas outputs the same year but decreased carbon dioxide intensities the next year. Districts with high spending rates also had a reduced carbon concentration according to the findings. Areas with a larger deficit percentage, on the other hand, had reduced carbon strength. Yang et al. [7] investigated the spatial variability properties of carbonic acid emission levels in 30 Chinese provinces from 2002 to 2013 and thoroughly explored the link between authorities and carbon intensity depending on the level of local legal provisions, social spending, and malfeasance. The worldwide Moran's I estimates of carbon pollution from 2002 to 2013 were found to be between 0.2 and 0.3, with a distributed lag coefficient of 0.2340, suggesting that pollutants in a given location rose by 0.234 percent for every extra 1 percent of emissions of CO_2 in the surrounding communities. According to the empirical findings, the amount of legal control and provincial graft are strongly adversely connected with local pollutant emissions, but the quality of social spending is considerably favorably associated with local emissions of carbon dioxide.

Li and Xu [25] investigated the impact of local government decision-making competition on carbon emissions. The research, which was focused on China's three metropolitan metropolises examined ways to avoid this impact. The findings revealed that rivalry in local government decision-making intensity is one of the primary causes of the regional "green paradox", i.e., that the effect of local government decision-making competition on carbon emissions has considerable local ethnic diversity and locational reliance and that the short-term energy fast break effect is greater than the long-term energy secondary effect. Moreover, local government decision-making competition has three interconnecting effects on greenhouse gases. Using the local authority panel data approach, Hao et al. [12] examined the influence of fiscal policy on China's air sustainability from 1995 to 2015. Based on the key features of China's devolution, a macroeconomic model was created. The study revealed an upside-down curved link between harmful gases and economic development, as well as a reversed U-shaped association between fiscal policy and GDP per capita, confirming that fiscal fragmentation was positively associated with GDP per capita at a constant rate.

Tariq and Jehan [20] used time series data from 1960 to 2013 to assess the direct and indirect impact of public spending on environmental deterioration using the fully modified ordinary least squares estimation approach. In the instance of Pakistan, the results indicated the presence of an ecological Kuznet contour. Fiscal spending, on the other hand, had a severe negative influence on carbon pollution. According to the authors, the data indicated that government spending in Pakistan was environmentally beneficial. Osuji and Nwani [26] investigated the efficiency of the Nigerian government's spending system in monitoring social, economic, and environmentally sustainable development goals (SDGs). The researchers implemented vector autoregression, a var model, and frequency response inferential analysis on quarterly data (Q1:2000–Q4:2018). The findings revealed that increased government expenditure had a negative impact on ecological integrity due to higher CO_2 emissions.

Cheng et al. [22] examined the effects of local government spending on pollutant emissions from the perspective of sociopolitical situations using the K-means cluster technique and a geographical logarithm division index modeling approach on data from 279 Chinese

cities. The findings revealed disparities in pollution levels in municipalities with poor demographic situations. The carbon intensity of local public spending and other government investments had the greatest influence on the carbon disparities of city groups with varied socioeconomic situations, followed by the volume of local government finance and public environmental investment. The proportions of public environmental and other spending had a limited influence. Using China's 12 urban settlements, the authors of [23] investigated the effects of the technique of Chinese-style federalism on local carbon pollution and regulatory effectiveness. The findings revealed that in China, devolution has a significant effect on local CO_2 emissions, primarily through factor misallocation of resources, financial prejudice, and environmental legislation.

Li [27] investigated local government judgment rivalry (LGC) as a major contributor to greenhouse gases. The findings revealed a three-stage nonlinear link between LGC and carbon pollution. The study also revealed that LGC has an impact on CO_2 emissions by disrupting component exchanges, public finance, and the execution of environmental legislation. The total emissions of the "informal settlement business" was USD 473/ton during the constantly increasing phase; a growth in tax income of CNY 84.63 million generates a one-ton increase in the carbon footprint under land financing. During the progressively rising stage, a CNY 23 million increase in leverage funding boosts carbon pollution by one ton. Wójtowicz et al. [21] proposed a distinctive and unique collection of parameters that influence the intensity of pollutant emissions using the logarithmic mean division index (LMDI). Data from 16 areas in Poland were applied for the period from 2010 to 2019 in this research. The study's findings confirmed that government investment helped to reduce CO_2 emissions at the local level, but environmental spending proved unproductive.

For the first time, the authors of [28] used a time-varying deviation approach and a dataset gathered from 2735 towns in China from 2003 to 2017 to investigate the statistical correlation between Chinese government remittances to resource-depleted towns and air pollution. The findings indicate that fiscal transfers to resource-depleted localities might dramatically cut greenhouse gases in China's resource-depleted municipalities.

3. Materials and Methods

In this research, we investigated the influence of local government expenditures on environmental safety by lowering CO_2 emissions at the municipal level from 1993 to 2020. Local government capital and recurrent investments were employed as explanatory variables in this study. The data for these predictor factors were from the Central Bank of Nigeria Statistical Bulletin, whereas the dependent variable (CO_2 emissions) is from the World Bank Development Indicators, measured in millions of tons. The entire dataset was converted to natural log for convenience of use. In the study, summary statistics were used to first examine the nature of the dataset and its normality status. The unit root test, homoscedasticity or same variance test, stability test, and test of explanatory variable interdependence, as well as some other diagnostics, were performed. An effect study was performed using the multiple regression technique to validate the effects of local government spending on carbon dioxide reduction. Finally, a correlational analysis was conducted out to assess the relationship between the variables.

The model specified for this study is as follows:

$$Y = \beta_0 + \beta X_1 + \beta X_2 + \mu_{it}$$

where:

Y = carbon pollutants (CO_2);
X_1 = local government recurrent spending;
X_2 = local government capital investments;
β_0 = *coefficient of the parameter estimate;*
μ_{it} = error term;

The above model can be specifically applied to this study as:

$$LnCO_2 = \beta_0 + \beta_1 LnLRX_1 + \beta_2 LnLCX_2 + \mu_{it}$$

where:

Ln = natural log of variables;
CO_2 = carbon dioxide emissions;
LRX = local government recurrent overhead;
LCX = local government capital investments;
β_0 = coefficient of the parameter estimate;
$\beta_1 - \beta_2$ = intercept;
μ_{it} = error term.
A priori, *we anticipate $\beta_1 > 0$, $\beta_2 > 0$.*

4. Results and Discussion

Table 1 contains summary statistics that clarify the nature of the dataset used in this inquiry. The mean values are significantly greater than the standard deviation values. This outcome suggests that the data distribution has a reduced spread, implying that data cluster around the mean.

Table 1. Summary statistics.

	CO_2	**LCX**	**LRX**
Mean	4.600120	4.465793	5.584906
Median	4.608013	4.990734	6.257139
Maximum	4.893802	6.332516	7.267246
Minimum	4.361441	1.406097	2.636912
Std. Dev.	0.139971	1.555252	1.711317
Skewness	0.375890	−0.748760	−0.625676
Kurtosis	2.514722	2.197719	1.835295
Jarque–Bera	0.934113	3.367261	3.409492
Probability	0.626845	0.185699	0.181819
Sum	128.8033	125.0422	156.3774
Sum Sq. Dev.	0.528984	65.30786	79.07232
Observations	28	28	28

Authors' computation, 2022.

The Kurtosis and Jarque–Bera coefficients, as well as their p-values, are also given in Table 1. The Kurtosis values are in the range of 2–3, indicating that the data distribution is normal. This information is supported by the Jarque–Bera *p*-value, which is greater than 0.05, indicating that the datasets are normally distributed.

The Levin, Lin, and Chu group unit root test (Table 2) was utilized in this investigation to verify that the datasets were all stationary at level or order zero. The goal was to guarantee that the regression result was not deceptive owing to temporal delays, which is why unit root testing was required.

The Ramsey RESET test (Table 3) and the CUSUM test (Figure 1) validate the stability of the regression model. The results of the two tests show that the model used in this inquiry is consistent and realistic. In the case of the CUSUM test, the appearance of the blue line between the two red dotted lines denotes the 5 percent level of significant bounds, implying model robustness. When the blue line crosses the red dotted lines from either direction, it means that the model is unstable and should not be trusted. However, in this situation, the model is proven to be reliable and pertinent to the investigation.

Table 2. Unit root test summary.

Series: Ln_CO_2, Ln_LCX, Ln_LRX Sample: 1993 2020				
Method	Statistic	Prob. **	Cross sections	Obs.
Null: Unit root (assumes common unit root process)				
Levin, Lin, and Chu t *	−2.4868	0.0064	3	79

* indicate that the unit root test tool applied is propounded by Levin, Lin, and Chu t. ** *p*-value is significant at level 1% < 5%. Authors' computation, 2022.

Table 3. Analytical checks.

Diagnostic Test	***p*-Value**	**Remarks**
Ramsey RESET Test for Stability	0.43	>0.05. The model is stable.
Heteroskedasticity Test: Breusch–Pagan–Godfrey	0.31	>0.05. There homoscedasticity or same variance.
Histogram Normality Test: Jarque–Bera	0.86	>0.05. The datasets are normally apportioned.
Standard Error of Regression	0.08	<1. The model prediction is correct.
Durbin–Watson	1.66	Approximately 2
LnLCX – VIF = 7.63		>10. Multicollinearity does not exist.
LnLRX – VIF = 7.63		>10. Multicollinearity does not exist.

Authors' computation, 2022.

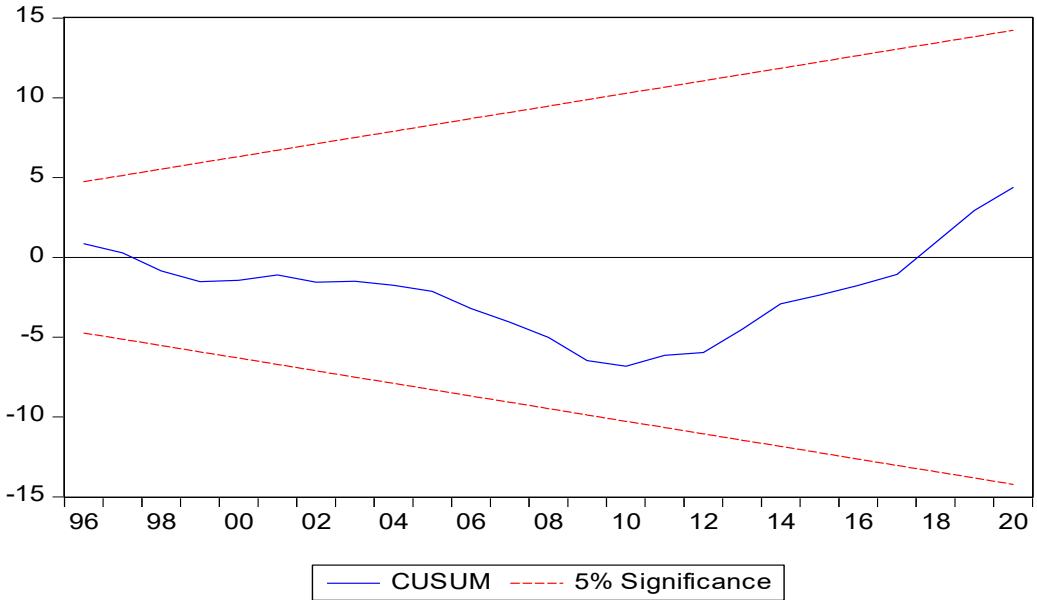

Figure 1. Stability test confirmation.

Table 3 displays the results of the numerous diagnostic tests that confirm the applicability of our regression model.

As depicted in Table 3, there is no Heteroskedasticity in the model, implying that the model has homogeneous variance across the board. There is also no multicollinearity, inferring that the independent variables are not in any way connected in operation. That is, there is no interconnection between the predictor factors that explains CO_2 emissions in Nigeria's local government regions.

Figure 2 depicts the normality of the histogram, which helps to establish that the model is standard. The statistical data stress Kurtosis, which is about 3, and the Jarque–Bera test, which has a *p*-value larger than 0.05. When the Kurtosis is 3, the data are normally

distributed, and when the *p*-value of the Jarque–Bera test is greater than the 5% level of significance, the model and dataset are both normal.

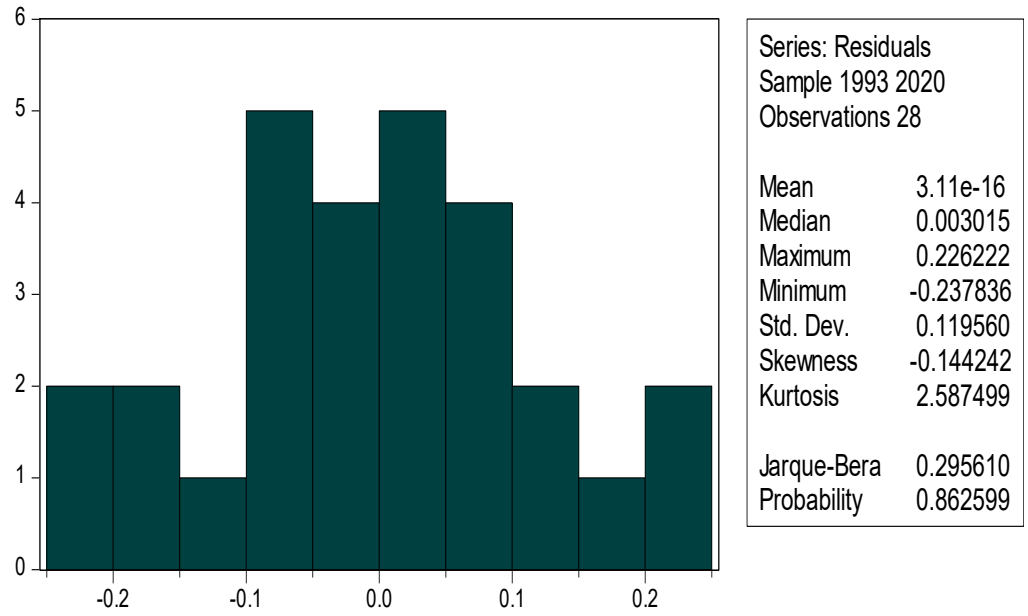

Figure 2. Normality test.

Table 4 explains the amount of connection between the variables (dependent and independent) employed in this research. The capital investment designated as LnLCX has a poor association with CO_2, implying that the capital expenditure of local governments is insufficient to reduce CO_2 pollution. This result indicates a significant hazard and the amount of worry pollution by local governments may cause if no external action is taken. The LnLRX regular investment has a modest association with greenhouse gas emissions, suggesting that local governments contribute resources on a regular basis to aid in the reducing CO_2 pollution in their area, as well as a modest link with the degree of pollution. This suggests that government at the local still needs to do more at this point because local areas are most affected by pollution.

Table 4. Correlation analysis.

Sample: 1993 2020 Included observations: 28			
Correlation t-Statistic Probability	Ln_CO_2	Ln_LCX	Ln_LRX
Ln_CO_2	1.000000		
Ln_LCX	0.301943	1.000000	
	1.614993	——	
	0.1184	——	
Ln_LRX	0.434671	0.932233	1.000000
	2.461049	13.13631	——
	0.0208	0.0000	——

Authors' computation, 2022.

Table 5 summarizes the results of the regression analysis, emphasizing the effect status of the predictor factors on environmental safety. To begin with, the local government's regular spending has a *p*-value of 0.92, which is larger than 0.05. These findings reveal that recurring local government spending has no significant impact on CO_2 emission reduction. Second, capital investment is important at the 10% level of significance, implying that

local government capital expenditure has a major influence on CO_2 emissions reduction, although there is still a need for greater capital investment to attain pollution-free local surroundings. Table 5 reveals that our model prediction was correct, with a value of 0.08, which is less than 1. The Durbin–Watson statistic confirms the absence of autocorrelation, and the F-statistics demonstrate that the study's model is appropriate. It also shows that the predictors have a positive impact on CO_2 emissions reduction. As a result, the local government can only reduce CO_2 emissions in the immediate vicinity with both ongoing outlay and major capital investments. The two spending plans can be combined to ensure that the environment is safe and sustainable.

Table 5. Regression analysis.

Dependent Variable: Ln_CO_2 Sample: 1993 2020 Included observations: 28				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln_LCX	0.061546	0.035852	1.716680	0.0995 ***
Ln_LRX	0.005901	0.059717	0.098812	0.9221
C	4.318881	0.303782	14.21705	0.0000
R-squared	0.681079	Mean dependent var		4.600120
Adjusted R-squared	0.625614	S.D. dependent var		0.139971
S.E. of regression	0.085644	Akaike info criterion		−1.874687
Sum squared residual	0.168704	Schwarz criterion		−1.636793
Log likelihood	31.24561	Hannan-Quinn criter.		−1.801960
F-statistic	12.27953	Durbin-Watson stat		2.059201
Prob (F-statistic)	0.000017			

Authors' computation, 2022. *** Significant @ 10% level.

5. Conclusions

In this study, we focused on the impact of local government spending on environmental safety. Owing to the health risks we confront every day in our local environs as a result of pollution, a green environment is everyone's primary priority at the moment. Scholars and researchers all around the globe are studying every possible way to prevent environmental pollution. As a result, local governments are not left out in the efforts to minimize pollution. In summary, in this study, we developed a new conclusion that demonstrates that local government spending arrangements incorporating both ongoing and substantial capital expenditure can aid in a reduction in greenhouse gas emissions. Most significantly, under this structure, capital investment is more beneficial. As a result, the battle to minimize the harm of CO_2 emissions to our ecosystems should not be only the duty of the central government but also be economically allocated to governments at the local level to tackle certain cases when practicable. Given these research outcomes, local governments should guarantee that any local refining of crude oils in their neighborhood is properly reported to the appropriate authorities in order to avoid penalties. In Nigeria, unlawful domestic crude oil refining has resulted in significant CO_2 emissions in the atmosphere, leading to black soot pollution throughout the Niger Delta areas. The environmental implications of the application of regular funds and capital investment in managing environmental threats will definitely lead to a reduction in haze in the ecosystem, as well as to the acquisition of green technology to force pollution out of the local vicinity, thereby reducing the mortality rate and environmentally related diseases such as tuberculosis, cardiovascular complications, and the infant death rate due to air pollution.

Proper management of local resources can also guarantee that local inhabitants in towns and cities receive adequate services [29]. This research suggests that local governments should employ the resources at their disposal to battle this threat through investment in green technology and renewable energy [30], in addition to involving state and federal officials as needed to examine the situation for the safety of local inhabitants. In addition, the application of appropriate environmental laws, fines, and penalties in local regions of

the country could be very helpful. It is also imperative that local governments organize adequate environmental safety training for local residents. This step requires supporting local awareness of environmental issues and the development of ways to mitigate impending hazards for everyone. In a nutshell, ecosystem safety and preservation should be popularized and taught in public places. Local governments should invest more in training local inhabitants on environmental conservation, thereby reducing the burning of fossil fuel and coal, which are the primary agents of CO_2 emissions. Local governments can also invest in affordable green technology and encourage individuals to use renewable energies such as solar.

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References

1. He, L.; Yin, F.; Zhong, Z.; Ding, Z. The impact of local government investment on the Carbon emissions reduction effect: An empirical analysis of panel data from 30 provinces and municipalities in China. *PLoS ONE* **2017**, *12*, e0180946. [CrossRef] [PubMed]
2. Purohit, I.; Purohit, P. CDM potential of windmill Pumps in India. *Int. J. Enrgy Sect. Mgt.* **2007**, *1*, 141–159. [CrossRef]
3. Basoglu, A.; Uzar, U. An empirical evaluation about the effects of environmental Expenditures on environmental quality in coordinated market economies. *Environ. Sci. Pollut. Res.* **2019**, *26*, 23108–23118. [CrossRef] [PubMed]
4. Al-Ghussain, L. Global warming: Review on driving forces and mitigation. *Environ. Prog. Sustain. Energy* **2019**, *38*, 13–21. [CrossRef]
5. Liu, T.; Wang, Q.; Su, B. A review of carbon labeling: Standards, implementation, and Impact. *Renew. Sustain. Energy Rev.* **2016**, *53*, 68–79. [CrossRef]
6. Cheng, S.L.; Fan, W.; Chen, J.; Meng, F.; Liu, G.; Song, M.; Yang, Z. The impacts of Fiscal decentralization on CO_2 emissions in China. *Energy* **2020**, *192*, 116685. [CrossRef]
7. Yang, Y.; Niu, G.; Tang, D.; Zhu, M. Spatial econometric analysis of the effect of Government governance on regional emission reduction: Evidence from China. *Pol. J. Environ. Stud.* **2018**, *27*, 2833–2842. [CrossRef]
8. Esty, D.C.; Porter, M.E. National environmental performance: An empirical Analysis of policy results and determinants. *Environ. Dev. Econ.* **2005**, *10*, 391–434. [CrossRef]
9. Omodero, C.O. Fiscal decentralization and environmental pollution control. *Int. J. Sust. Dev. Plan.* **2021**, *16*, 1379–1384. [CrossRef]
10. Omodero, C.O.; Alege, P.O. Government expenditure fiscal delegation and Environmental quality: A study of Nigeria. *Int. J. Sust. Dev. Plan.* **2022**, *17*, 949–955. [CrossRef]
11. Song, M.; Du, J.; Tan, K.H. Impact of fiscal decentralization on green total factor Productivity. *Int. J. Prod. Econ.* **2018**, *205*, 359–367. [CrossRef]
12. Hao, Y.; Chen, Y.F.; Liao, H.; Wei, Y.M. China's fiscal decentralization and Environmental Quality: Theory and an empirical study. *Environ. Dev. Econ.* **2020**, *25*, 159–181. [CrossRef]
13. Le, H.P.; Ozturk, I. The impacts of globalization, financial development, government Expenditures, and institutional quality on CO_2 emissions in the presence of environmental Kuznets curve. *Environ. Sci. Pollut. Res.* **2020**, *27*, 22680–22697. [CrossRef]
14. Wang, J.; Li, H. The mystery of local fiscal expenditure and carbon emission growth in China. *Environ. Sci. Pollut. Res.* **2019**, *26*, 12335–12345. [CrossRef]
15. Mahesh, A.; Jasmin, K.S.S. Role of Renewable Energy Investment in India: An Alternative to CO_2 Mitigation. *Renew. Sustain. Energy Rev.* **2013**, *26*, 414–424. [CrossRef]
16. Framstad, N.C.; Strand, J. Energy Intensive Infrastructure Investments with Retrofits in Continuous time: Effects of Uncertainty on Energy Use and Carbon Emissions. *Resour. Energy Econ.* **2013**, *41*, 1–18. [CrossRef]
17. Zhang, D.Z.; Zhan, Q.W.; Chen, Y.C.; Li, S.Y. Joint Optimization of Logistics Infrastructure Investments and Subsidies in a Regional Logistics Network with CO_2 Emission Reduction Targets. *Transp. Res. Part D Transp. Environ.* **2018**, *60*, 174–190. [CrossRef]

18. Lee, K.H.; Min, B.; Yook, K.H. The Impacts of Carbon (CO_2) Emissions and Environmental Research and Development (R&D) Investment on Firm Performance. *Int. J. Prod. Econ.* **2015**, *167*, 1–11.
19. Hecto, J.; Opper, S. The Relationship between Fiscal Federalism and CO_2 Emissions in China. Master's Thesis, School of Economics and Management, Lund University, Lund, Sweden, 2017.
20. Tariq, A.; Jehan, Z. Fiscal spending and carbon emissions: Evidence from Pakistan. *IIIE J. Econ. Financ.* **2020**, *1*, 1–13.
21. Wójtowicz, K.A.; Szołno-Koguc, J.M.; Braun, J. The Role of Public Spending in CO_2 Emissions Reduction in Polish Regions: An LMDI Decomposition Approach. *Energies* **2022**, *15*, 103. [CrossRef]
22. Cheng, S.; Chen, Y.; Meng, F.; Chen, J.; Liu, G.; Song, M. Impacts of local public Expenditure on CO_2 emissions in Chinese cities: A spatial cluster decomposition analysis. *Resour. Conserv. Recycl.* **2021**, *164*, 105217. [CrossRef]
23. Xu, H.; Li, X. Effect mechanism of Chinese-style decentralization on regional carbon emissions and policy improvement: Evidence from China's 12 urban agglomerations. *Environ. Dev. Sustain.* **2022**, *12*, 32–43. [CrossRef]
24. Xiao, H.; Liu, H.; Liu, Y. The effect of local government expenditure on CO_2 Emissions: An empirical investigation in China. *Int. J. Appl. Environ. Sci.* **2013**, *8*, 271–281.
25. Li, X.; Xu, H. Effect of local government decision-making competition on carbon Emissions: Evidence from China's three urban agglomerations. *Bus. Strat. Environ.* **2020**, *29*, 2418–2431. [CrossRef]
26. Osuji, E.; Nwani, S.E. Achieving sustainable development goals: Does government Expenditure framework matter? *Int. J. Manag. Econ. Soc. Sci.* **2020**, *9*, 131–160. [CrossRef]
27. Li, X. Local government decision-making competition and regional carbon emissions: Experience evidence and emission reduction measures. *Sustain. Energy Technol. Assess.* **2022**, *50*, 101800. [CrossRef]
28. Li, X.; Wang, D. Does transfer payments promote low-carbon development of resource-Exhausted cities in China? *Earth's Future* **2022**, *10*, e2021EF002339. [CrossRef]
29. Amesho, K.T.T.; Edoun, E.I.; Naidoo, V.; Pooe, S. Sustainable competitive advantage through technology and innovation systems in the local government authorities. *Afr. Public Serv. Deliv. Perform. Rev.* **2022**, *10*, 1–19. [CrossRef]
30. Amesho, K.T.; Edoun, E.I. Financing Renewable Energy in Namibia—A Fundamental Key Challenge to the Sustainable Development Goal 7: Ensuring Access to Affordable, Reliable, Sustainable and Modern Energy for All. *Int. J. Energy Econ. Policy* **2019**, *9*, 442–450. [CrossRef]