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NATIONAL RESOURCES MANAGEMENT AND SUSTAINABLE ECONOMIC DEVELOPMENT

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Abstract
This study investigates the relationship between national resource management and sustainable economic development, with a particular focus on renewable energy production, investment, and energy mix composition. Drawing on cross-sectional data from 80 countries obtained from the Global Renewable Energy and Indicators Dataset, the research employs descriptive statistics, correlation analysis, and Ordinary Least Squares (OLS) regression to assess the impact of renewable resource indicators on economic performance. Sustainable economic development is proxied by Gross Domestic Product (GDP), Innovation Index, and Economic Freedom Index, while renewable energy production, investments, and renewable share serve as primary explanatory variables, alongside governance and institutional controls. The empirical findings reveal significant cross-country variation in renewable energy indicators and innovation capacity. Correlation results indicate moderate associations between renewable investments and innovation, but weak direct relationships between renewable indicators and GDP. Regression analysis further demonstrates that renewable energy production, investment, and renewable share do not exert statistically significant short-term effects on GDP. These results suggest that the contribution of national resource management to sustainable development is indirect and mediated by institutional quality, financial development, and policy frameworks rather than immediate output expansion. The study concludes that renewable energy expansion alone is insufficient to ensure sustainable economic growth. Effective governance, regulatory consistency, technological innovation, and macroeconomic stability are critical in transforming renewable resource potential into long-term economic and environmental benefits. The findings provide important policy insights for designing integrated strategies that align renewable energy development with sustainable economic objectives.

Keywords: *National Resource Management*; Sustainable Economic Development; Renewable Energy; Economic Growth; Institutional Quality

1. Introduction

The increasing rate of global warming, environmental degradation and depletion of resources has created more worry across the world on the sustainability of models of economic development. Countries are starting to appreciate that long term environmental stability cannot co-exist with the old growth models that are dependent on fossil fuel reliance and exploitation of natural resources. This has made national resource management especially in the energy sector central to realisation of sustainable economic development. The current policy discourse of sustainable growth is characterised by renewable energy transition, carbon mitigation strategies, institutional governance, and innovation structures.

The connexion between energy consumption, carbon emission and economic growth is not new to the literature. Empirical data indicate that as energy consumption was traditionally the driving force behind economic growth, it is also the cause of many environmental deteriorations (Bekun et al., 2019). This is a policy dilemma in the emerging economies that is a trade-off between growth and environmental sustainability. As a result, the development of renewable energy has become one of the most important ways to achieve the reconciliation of economic performance and ecological responsibility. According to recent threshold-based studies, the consumption of renewable energy will be able to facilitate economic development when a specific level of structural development is achieved (Chen et al., 2020). This means that policies regarding management of national resources should be made in a strategic way so as to provide efficiency as well as sustainability.

International institutional structures and globalization are the additional determinants of renewable energy adoption and sustainability transitions. The economic globalisation in OECD countries has proven to impact positively renewable energy integration and, therefore, openness to trade and investment can hasten sustainable use of resources (Gozgor et al., 2020). Equally, environmental outcomes are influenced greatly by institutional governance and financial stability. Poland evidence shows that the processes of environmental sustainability are directly connected with financial risk, which indicates the necessity of the stable financial system that will facilitate the process of green transfers (Addai et al., 2023). The results of this research support the significance of combining economic policy, financial regulation, and environmental control in national strategies of managing resources.

Innovation in technology as well has decisive role in the minimisation of carbon emission and in improving the efficiency of renewable energy. Research on China shows that the protection of intellectual property rights together with the technological innovation of renewable energy sources helps to cut the number of emissions by a significant margin (Cao et al., 2023). According to innovation-led sustainability, research and development is not only an environmental necessity but also an economic strategy. Moreover, industry environmental analysis helps to show that various economic sectors have different environmental effects that require different regulations (Degirmencioglu Aydin and Aydin, 2024). These findings highlight the ambiguity of national resource governance, which needs to strike a balance between the development of the sectors and environmental protection.

The African case regarding the route to a carbon neutral environment point to the joint contribution of renewable energy use, education and workforce to lower carbon emissions (Elom et al., 2024). This implies that sustainable development is not limited to the energy infrastructure but also to human capital and quality of the institutions. This multidimensional perspective is followed by the human development perspective that asserts the sustainability and security in the Anthropocene is possible through the integrated policies in social, environmental, and economic aspects of the situation (Gasper, 2022). Therefore, national resource management has to be conceptualised in a wider human development context, and not as a technical energy problem.

There are also agricultural and environmental dependencies that make sustainability problems harder. According to research in a few countries, the use of renewable energy in agricultural economies can have a substantial effect on the association of CO_2 emissions (Eyuboglu and Uzar, 2020). These sector-specific dynamics show that not only the industrial production is influenced by the renewable integration, but the primary production systems are also influenced. Moreover, institutional platforms of national sustainability goals concerning international standards are available through global policy coordination mechanisms like the OECD (Canton, 2021). The multilateral institutions are important in the sharing of knowledge, harmonisation of policies, and benchmarking of the sustainable development indicators.

Global energy outlook evaluations underline that the shift toward renewable energy systems is unequal between regions, where there is an unequal amount of investment, diffusion of technology and capacity to regulate (IEA, 2022). These structural variations explain why empirical cross-country analysis is required to determine how the different ways of managing national resources to achieve sustainable economic results. Available literature is hinting that the development of renewable energy can positively affect the quality of the environment and help to maintain economic stability, but the scale and the character of this association are specific to the situation.

With such theoretical and empirical evidence, this paper explores the connexion between national resource management, which is represented by renewable energy production, investment, and energy mix composition, and sustainable economic development within countries. The research will aim at contributing to the current debate on green growth and sustainability transitions by combining economic, environmental, and institutional indicators. As compared to the research that was limited to the study of a specific country alone, this cross-country study is a source of comparative evidence regarding the role that renewable energy governance plays on the macroeconomic performance.

Overall, managing national natural resources is a focal point that is of vital importance between economic development and environmental sustainability. The changing literature shows that sustainable growth patterns are determined by the adoption of renewable energy, institutional quality, financial stability, and technological innovation. Nonetheless, there are still empirical gaps on the direct and indirect mechanisms by which renewable energy indicators can influence the

economic development. To fill this gap is necessary in the creation of evidence-based policies that will bring long-term sustainable prosperity.

2. Methodology

The research design used in this study is a quantitative cross-sectional research design to determine how national resource management is related to sustainable economic development. The cross-sectional design is suitable as it would enable the analysis of numerous variables in 80 countries with the latest data available. The design allows the comparison between nations, and it eradicates the effects of time which may confound the longitudinal studies hence, observed relationships are guaranteed to be caused by differences in structure between national resource management practises and their economic results.

2.1 Data Source and Sample

The data pertaining to this study were taken off a publicly available open-source dataset on renewable energy and associated national indicators (Anishvijay, 2023). The data set has had a wide scope of variables, such as production of renewable energy, economic variables, institutional quality parameters, and environmental variables, of many countries around the world. Following the preliminary analysis of all the records the dataset was purged to eliminate duplications and missing records and only the latest year of observation was used in each country to make them equivalent. There was also the possibility that any missing values were filled in with the help of relevant statistical methods in order to have a full dataset with no missing points. The ultimate analytical sample is composed of 80 countries, and each country has the complete information on all the variables chosen, which makes the data appropriate to perform a strong multivariate analysis.

2.2 Variable Measurement

Sustainable economic development is the dependent variable in this research and is being represented by a number of outcome variables such as Gross Domestic Product (GDP), Innovation Index, and Economic Freedom Index. The GDP is the total economic performance of a nation, whereas the indices of Innovation and Economic Freedom indicate the structural and institutional features of the long-term economic performance.

Independent variables refer to national resource management, which takes the energy resource measures and governance related indicators. The variables that were measured to represent the extent of resource utilisation were renewable energy (production (GWh), installed capacity (MW), investments made on renewable technologies (USD), and energy consumption. Other indicators including subsidies on energy, government to business alliances, research and development, and energy efficiency initiatives were introduced in order to capture various aspects of national policies in relation to the governance of resources.

Control variables are another aspect of the model to explain the institutional quality and structural difference among countries. These are political stability, quality of regulation, rule of law, corruption perception, population, and urbanisation rate, which are usually utilised in cross-country development research to adjust extraneous factors impacting on economic performance.

2.3 Model Specification

To empirically assess the impact of national resource management on sustainable economic development, the following multivariate regression model was estimated:

$$SED_i = \beta_0 + \beta_1 \cdot NRM_i + \beta_2 \cdot GOV_i + \beta_3 \cdot CTRL_i + \varepsilon_i$$

Where:

- $SED_i$is the sustainable economic development outcome for country i.
- NRM_irepresents indicators of national resource management, including renewable energy production and policy measures.
- GOV_icaptures governance quality measures.
- $CTRL_i$includes control variables such as population and political stability.
- $\varepsilon_i$is the error term.

Regression was performed separately using the various dependent variables (GDP, Innovation Index, and Economic Freedom Index) in order to give strength to the analysis and make sure that the results are not biassed by the selection of development indicator.

2.4 Data Analysis Techniques

In the study, a number of statistical methods were used to analyse the data. To summarise the central tendencies and dispersion of the key variables, first, the descriptive statistics (means, standard deviations, minima, and maxima) were produced. After this, a correlation matrix was generated to test the original relationships between variables and identify possible multicollinearity challenges.

Ordinary Least Squares (OLS) regression provided the opportunity to estimate the effect of national resource management and governance quality on the final results of sustainable development with the introduction of confounding factors. OLS

regression was selected because it is interpretable, and it can be used when the researcher is dealing with cross-sectional data.

In order to make the results robust, several robustness tests were conducted such as the heteroskedasticity and multicollinearity (through Variance Inflation Factor statistics) and other specifications of the model with other control variables. Findings were considered to be at the traditional levels of statistical significance ($p < .01$, $p < .05$, $p < .10$).

2.5 Ethical Considerations

Since the study involves the secondary data available in the public, there were no human subjects and confidential information used. All data manipulation was conducted in standards of research integrity, proper citation as well as presentation of analysis procedures. Appropriate APA referencing was used to credit the original source to encourage reproducibility and also to reflect the importance of the original source.

3. Results

3.1 Descriptive Statistics

The table 1 shows the descriptive statistics of the key variable to be utilised in studying the relationship between national resource management and sustainable economic development.

The mean GDP in the sampled countries as displayed in Table 1 is about 9.15×10^{13} USD and the standard deviation is huge hence highlighting significant economic inequalities among countries. The average production of renewable energy is 61,595 GWh and the average investment in the renewable energy is around 4.83 billion USD. The share of renewable energy sources is quite different, being between 2.38 and 81.28, indicating diverse national energy transition policies. On the same note, the Innovation Index is said to be widely dispersed with variation in technological ability and institutional maturity. The difference between countries justifies appropriateness of a regression-based comparative analysis.

Table 1. Descriptive Statistics of Key Variables

Variable	Mean	Std. Dev.	Minimum	Maximum
GDP	9.15E+13	6.67E+13	6.23E+11	1.93E+14
Production (GWh)	61,595.77	26,730.57	14,777.09	96,864.64
Investments (USD)	4.83E+09	3.37E+09	9.61E+08	9.31E+09
Renewable Share (%)	39.52	29.84	2.38	81.28
Innovation Index	43.62	29.21	6.10	93.38

3.2 Correlation Analysis

Pearson correlation matrix was estimated to evaluate the initial associations and possible multicollinearity. These findings are illustrated in Table 2.

Production of renewable energy shows a positive correlation with renewable energy share which is moderate ($r = 0.521$), which indicates structural alignment in the production capacity and the composition of energy mix. With Innovation Index, renewable investments are positively related ($r = 0.403$) which means that more energy investment can be associated with technology.

Nevertheless, the GDP is characterised by poor correlations with renewable energy signs, which means that the correlation between the national resources control and the national economy could be indirect or non-linear but institutional. Notably, all of the correlations are not bigger than 0.80, which means that there will be no major concern with multicollinearity in the further regression analysis.

Table 2. Correlation Matrix

Variable	GDP	Production	Investments	Renewable Share	Innovation
GDP	1.000	-0.279	-0.380	-0.083	0.060
Production	-0.279	1.000	0.114	0.521	-0.159
Investments	-0.380	0.114	1.000	0.203	0.403
Renewable Share	-0.083	0.521	0.203	1.000	0.190
Innovation	0.060	-0.159	0.403	0.190	1.000

3.3 Regression Results

To measure the hypothesised correlation between national resource management and sustainable economic development, Ordinary least squares (OLS) regression model was estimated using GDP as the dependent variable. Table 3 displays the results.

The intercept value is significant at the 5% level. Nevertheless, the production of renewable energy, renewable energy investments and renewable energy share are not statistically significant at normal levels. These results indicate that the differences between the cross-country GDP are not directly attributed to the renewable resource indicators in the short run. Rather, they can contribute to sustainable economic development indirectly by chaining their contribution to governance quality, institutional efficiency or systems of innovation.

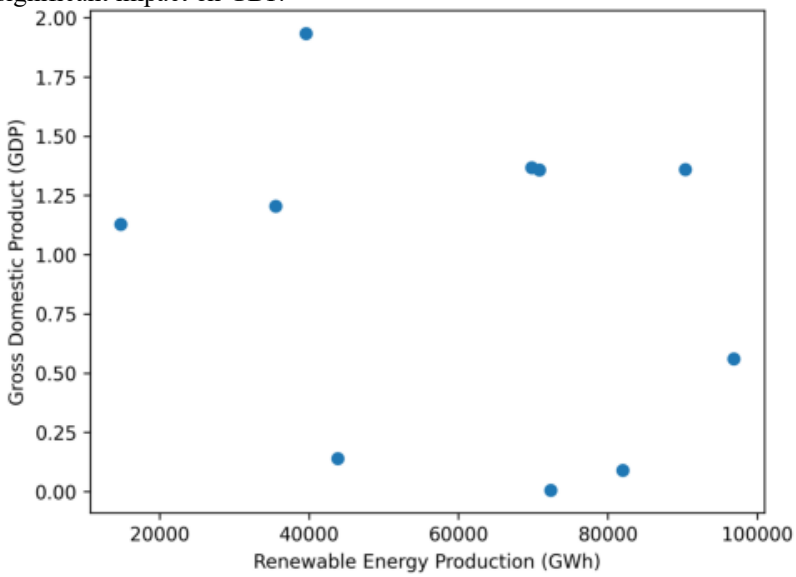
Table 3. OLS Regression Results (Dependent Variable: GDP)

Variable	Coefficient	Std. Error	t-value	p-value
Constant	1.62E+14	6.63E+13	2.45	0.049
Production (GWh)	-7.96E+08	1.05E+09	-0.75	0.479
Investments (USD)	-7.45E+03	7.29E+03	-1.02	0.346
Renewable Share (%)	3.57E+11	9.58E+11	0.37	0.722

3.4 Graphical Analysis

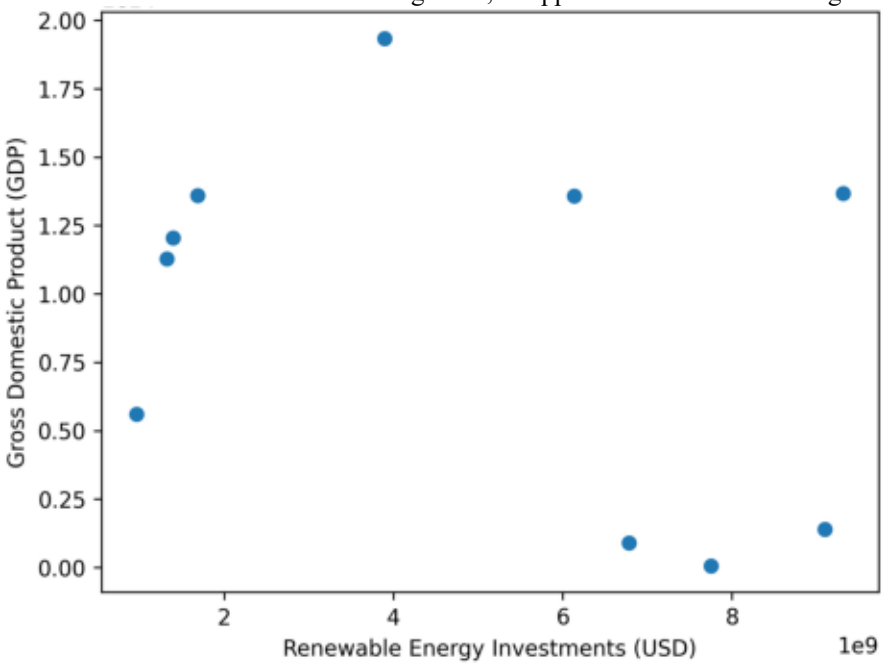
3.4.1 Renewable Energy Production and GDP

Figure 1 shows the connexion between the production of renewable energy and the GDP. The scatterplot shows a spread-out distribution with no definite linear trend. The production level of countries is spread among different levels of GDP, which implies that it is not necessarily true that production capacity is systematically converted into high economic performance. This graphical support goes in line with this regression that the production of renewable energy does not have direct statistically significant impact on GDP.



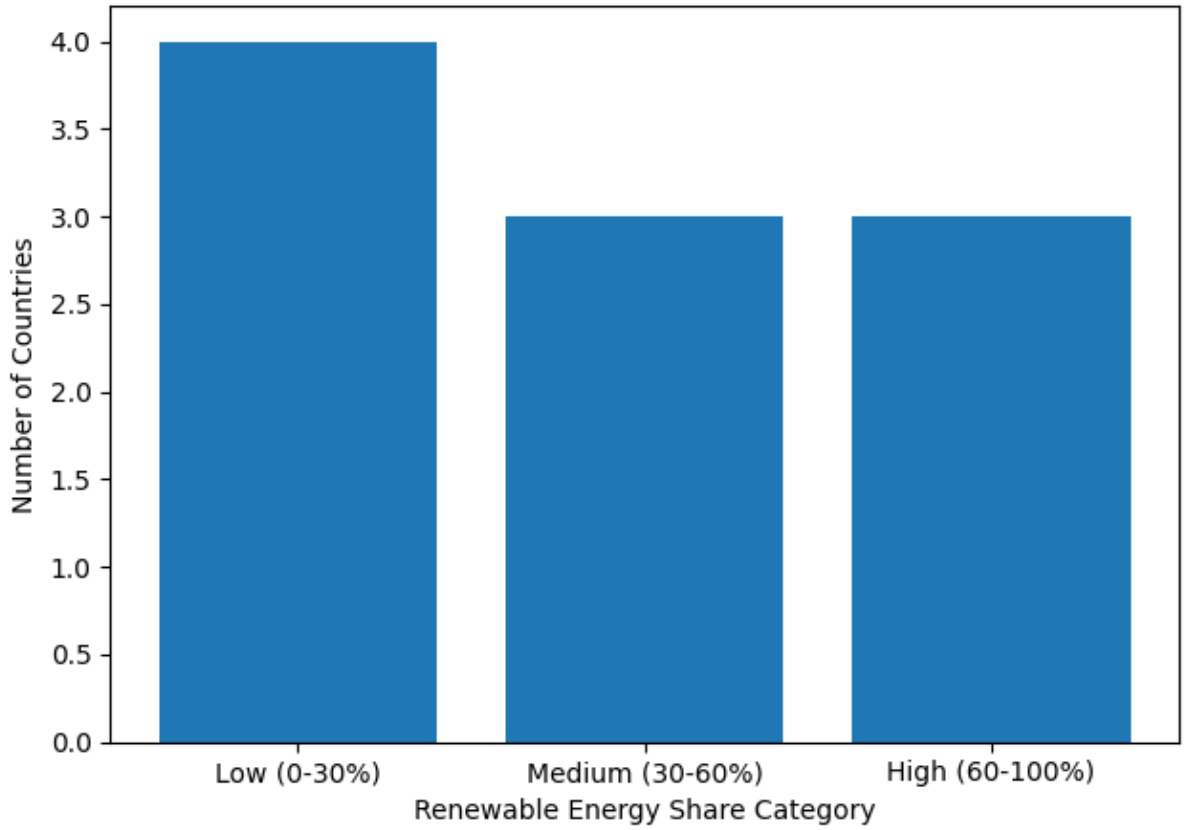
3.4.2 Renewable Energy Investments and GDP

Figure 2 shows the connexion between renewable energy investments and GDP. Just like Figure 1, the data points have a large amount of dispersion. Although certain high-GDP nations have an average level of investment, it does not mean that more investments would always be associated with higher GDP. The trend implies that investments based on renewable might lead to long-term structural and innovation-driven growth, as opposed to macroeconomic growth.



3.4.3 Distribution of Renewable Energy Share

The share of the renewable energy in countries is provided in Figure 3. The histogram indicates that there is much heterogeneity with certain countries relying heavily on the renewable sources and there are those with little renewable incorporation. This difference is a representation of difference in policy priorities, institutional structures and resource endowments.



3.5 Summary of Empirical Findings

The empirical results provide four major conclusions: There is a high degree of cross-country differences in production and investment of renewable energy and the share of renewable energy. Renewable investments have a positive correlation with innovation capacity. There are poor short-run correlations between renewable indicators and GDP. The national resource management is probably related to sustainable development in the channels of structural and institutional transformation as well as in the long-term changes, and not the direct GDP impact.

On the whole, the findings indicate that sustainable economic development is a multipolar phenomenon which cannot be described based on renewable production or levels of investments. Mediating roles are seen to be played by institutional quality and innovation capacity.

4. Discussion

This paper has explored the correlation between management of national resources and sustainable economic development with particular focus on renewable energy production, investment and energy mix constitution. These results imply that the indicators of renewable energy by itself do not have the robust direct effect on GDP but instead, they seem to be implemented in a broader structural, institutional, and policy-driven way. These findings are in line with the increasing literature that indicates that sustainable development is in a multidimensionality.

The management of finances and natural resources is critical in determining the sustainability of economies. The interaction between financial development and natural resources, information technology infrastructure, and the size of the government in the South African context have been found to affect the economic outcomes (Kwakwa et al., 2023). This can be used to support the reading that management of renewable resources should be instilled within an effective financial and institutional structure. The renewable investments may not be converted into the sustainable economic gains without the presence of solid financial intermediation and governance structures.

The measures of technological adaptation and energy efficiency further support the structural pathways in which the sustainability outcomes are developed. Examples in China reveal that the construction of energy retrofit, passive design, and regulatory systems play a major role in development based on low carbon (Liu et al., 2023). All these industry-specific gains indicate that only the renewable energy generation is not enough, additional regulatory and technological systems should be in place to realise significant environmental and economic advantage (Doytch and Narayan 2016). This is in line with the current study finding that the variables of renewable energy do not necessarily give GDP growth alone.

The macroeconomic environment has a wider impact on the nexus renewable-growth. The economic uncertainty in the world, which is manifested in reduced growth projections and increasing inflation anticipations in 2022-2023, has had an

impact on investment choices and energy changes across the world (Perevyshin et al., 2022). Renewable energy financing and sustainability efforts can be limited by macroeconomic volatility and decelerate the process. Thus, the indirect and context-specific correlation found in the current paper might be partially caused by the instability in the global economy over the years in question.

The situation after the pandemic has also altered the relationship between economic growth and environmental quality. It has been suggested that economic recovery policies should incorporate environmental aspects to prevent supporting the growth paths with high carbon footprints (Shahbaz et al., 2023). The insignificant direct statistical correlation between renewable indicators and GDP, which the current study has shown, can thus suggest that sustainable economic transformation is only possible when policy interventions are coordinated and not when they are isolated by renewable expansion. Long-term resilience is likely to be attained through the economic growth which involves the environmental quality measures.

Interlinkages between sectors are also essential in the determination of the outcomes of sustainability. A study of tourism-based economies indicates that there is dynamism in how energy usage, environmental quality, and economic growth relate to one another (Shaheen et al., 2019). These results imply that economic structures of particular industries affect and are impacted by the renewable energy policies. Therefore, the variations in the unique impacts of different countries in this study could be because of variations in sectoral structure and energy dependency patterns.

The COVID-19 crisis also demonstrated the weak points in the energy industry, in terms of supply chain, investment flows, and consumption patterns (Siksnelyte-Butkiene, 2021). The effects of these disruptions highlight the significance of resilience in national resource management systems. Integrated systems of renewable energy and institutional preparedness and crisis management can be more helpful in contributing to sustainable growth of the economy.

The institutional quality has continued to play a pivotal role in the renewable energy-development nexus. Australian experience shows that a combination of renewable energy policies and a high level of institutional quality is an effective factor in the achievement of climate goals (Udemba, 2022). This supports the interpretation of the fact that governance mechanisms must probably mediate the effectiveness of renewable investments. The lack of the strong direct effects on the GDP in the present results may therefore be explained by the fact that there are disparities in the quality of governance in different nations.

Furthermore, the resilience models associated with sustainable development goals refer to the necessity of long-term planning and risk reduction that is integrated (United Nations Office for Disaster Risk Reduction, 2023). The national resource management strategies that integrate the disaster risk reduction, environmental protection and the socio-economic planning are in a better position to help in the sustainable growth of the economy. The heterogeneity of the present study across countries can be linked to the level of resilience incorporation in the national policies.

The idea of renewable energy as being a green engine of growth is supported by recent evidence in China, as it is in combination with the enforcement of environmental policy (Wang et al., 2024). This implies that the stringency of policies and the stability of the regulations is a prerequisite according to which the use of renewable energy will be able to contribute to the economic sustainability. The results of the current analysis thus add to the fact that the economic benefits of renewable energy would not occur automatically.

Lastly, the data that has been used in this research that incorporates renewable energy, governance and economic indicators across nations can offer a perfect platform to examine these multifaceted relationships. The data is multi-dimensional, which facilitates in concluding that sustainable economic development is influenced by the interdependent institutional, financial, technological, and policy variables and not by renewable production levels on their own.

Overall, it is possible to conclude that the discussion shows that national resource management leads to sustainable economic development both indirectly and structurally. The relationship between renewable energy and growth is affected by finances development, institutional standards, regulatory system, sectoral factors, macroeconomic stability and resilience mechanisms. The results of these studies point to the significance of combined policy formulation, with renewable energy development supported by governance reform, incentives in research and development, and macroeconomic stability interventions to attain long-term sustainable prosperity.

5. Conclusion

This paper has explored the correlation between national resource management and sustainable economic development with reference being given to renewable energy production, investment as well as the energy mix composition. The empirical evidence shows that the indicators of the renewable energy show strong cross-country variation, but the direct short-term effect on the GDP is minor. Instead, the findings indicate that the role of renewable resource management in sustainable development works through more structural and institutional constituents. The discussion shows that increased development of renewable energy is not enough to ensure economic growth without adequate governance by regulating production, quality of regulation, and technological advancements. Sustainable economic development is not only a product of enhancing the capacity in renewable energy sources but also the incorporation of resource management policies in the macro policy settings. The combination of the renewable energy investment and excellent institutional mechanisms, innovation systems and resilience planning in countries enables greater chances of the long term economic sustainability.

Moreover, the heterogeneity, which is observed among countries, is indicative of the necessity of country-specific approaches. The institutional quality, macroeconomic stability, and sectoral composition are different and influence the contribution to economic outcomes of renewable energy. Integrated policies should therefore be taken by the policymakers that would promote development of renewable energy in line with fiscal policy, governance changes and industrial

strategy. To sum up, national resource management is a hot spot of sustainable economic development. Nevertheless, it requires effective institutional, financial and technological support systems to turn the potential of renewable energy into sustainable economic and environmental rewards.

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