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Nonlinear Regression Analysis of the Relationship between Sustainable Development and the Green Economy in Algeria

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Abstract:

This study investigates the relationship between sustainable development and the green economy in Algeria from 2011 to 2021, with an emphasis on understanding causality and dependency. The study investigates the policy and practice implications of this link, based on the idea that sustainable development is the cause and green economy is the effect. We employed nonlinear regression analysis to describe the intricate and dynamic nature of the connection between sustainable development and green economy. According to the result of the study, sustainable development is the driving force behind the growth and development of green economy activities. Therefore, it is recommended that Algeria prioritize sustainable development policies to enhance its green economy activities.

Keywords: Algeria; green economy; relationship; nonlinear regression; sustainable development.

Jel Classification Codes: O13, Q56.

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1. Introduction

The world is facing mounting environmental issues and increasing pressure to address climate change. In response, sustainable development and the green economy have gained significant attention in recent years. Despite being perceived as separate concepts, there is a growing debate about the relationship between the two. Recent data suggests that investment in green economy initiatives has been on the rise globally, with a record $243 billion invested in renewable energy in 2021 alone (Fang et al., 2022, p. 1144). At the same time, countries around the world have also been making progress in achieving sustainable development goals, with 71 countries reporting a decline in poverty rates and 45 countries reducing their carbon emissions between 2016 and 2021 (Chen et al., 2022, p. 3).Furthermore, more than 14 % of green investments have been allocated to promoting renewable energies and carbon dioxide capture and storage technologies. Despite these positive developments, there is still much work to be done to address the complex challenges facing our planet.

In Algeria, there has been a growing interest in promoting green economy activities, which are seen as crucial for achieving sustainable development. However, the relationship between these two concepts remains a topic of debate. Therefore, the primary objective of this study is to answer the following question:

To what extent does sustainable development drive the growth and development of the green economy in Algeria, and how can effective policies be developed and implemented to support this relationship?

The hypothesis of this study is:

- Null Hypothesis (H0): There is no statistically significant relationship between sustainable development and the green economy in Algeria from 2011 to 2021.
- Alternative Hypothesis (H1): There is a statistically significant relationship between sustainable development and the green economy in Algeria from 2011 to 2021.

The importance of this study lies in its investigation of the relationship between sustainable development and the green economy

in Algeria. Sustainable development is a critical issue in today's world, as it involves balancing economic growth with social and environmental concerns. The green economy is also becoming increasingly important, as it focuses on creating sustainable economic growth while minimizing environmental impact.

The main objectives of this study are:

- To analyze the relationship between sustainable development and green economy in terms of causality and interdependence.
- To identify the factors that contribute to the growth of green economy initiatives, such as investments in sustainable development in Algeria.
- To examine the implications of this relationship for policy and practice, and to suggest ways in which Algeria government and other stakeholders can foster the growth of both sustainable development and green economy initiatives.

The methodology employed in this study can be described as a mixed approach, combining analytical and descriptive methods with a quantitative approach. To achieve this, a comprehensive review of existing literature was conducted, which encompassed academic publications, government reports, and other relevant sources. Then, Nonlinear regression analysis was employed to describe the relationship between sustainable development and green economy activities. The study sought to investigate the policy and practice implications of this link, with a view to providing recommendations for enhancing green economy activities in Algeria. The aim of the methodology was to provide a comprehensive and in-depth understanding of the relationship between sustainable development and green economy. Through the use of both qualitative and quantitative data, the methodology enabled a nuanced analysis of this complex relationship, yielding valuable insights that can inform policy and practice in the field of sustainability.

2. Literature review

Two ideas that have received a lot of attention recently as the world works to solve the problems of climate change and environmental deterioration are sustainable development and the green economy. Although there is growing agreement that both ideas are essential for building a more sustainable future, there is still disagreement over how they interact. We will examine the concepts of sustainable development and the green economy in this literature study, as well as the ongoing discussion of their interrelationship.

Sustainable development is defined by the United Nations as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland et al., 1987, p. 43). This definition highlights the importance of balancing economic, social, and environmental considerations in decision-making, with a focus on ensuring intergenerational equity. A green economy, on the other hand, is one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011, p. 9). This definition emphasizes the need for economic growth to be decoupled from environmental degradation, and for the development of new technologies, products, and services that support sustainable consumption and production patterns.

Although universal agreement that both are crucial for creating a sustainable future, there is dispute over the relationship between sustainable development and the green economy. (Agbedahin, 2019; Mumtaz & Smith, 2019; Arestis et al., 2022) argue that green economy is necessary precondition for sustainable development, as it promotes environmentally sustainable practices that reduce negative impacts on the planet. Conversely, proponents of sustainable development like (Bina, 2013; Lavrinenko et al., 2019; Mikhno et al., 2021) claim that supporting sustainable development methods that promote environmental stewardship, social equality, and economic competitiveness is the key to attaining a green economy. These proponents claim that by embracing a holistic approach to

development that incorporates the long-term effects of economic growth, we may create a more sustainable and resilient economy.

Sustainable development advocates emphasize the importance of policies and practices that promote responsible resource use, reduce waste and pollution, and build more resilient communities. For example, sustainable agriculture practices can reduce the environmental impact of food production while also promoting healthy ecosystems and biodiversity (Shahmohamadloo et al., 2022, p. 1201). Sustainable transportation systems can reduce carbon emissions and improve air quality while also promoting economic growth and social equity. These practices can provide a solid foundation for a green economy by promoting environmental stewardship and social equity. Critics of this view argue that a narrow focus on green growth may not be sufficient to achieve sustainable development, and that broader social and economic considerations must be taken into account. They point out that the green economy may not address issues such as inequality, poverty, and social exclusion, which are critical to achieving sustainable development. (Cook & Smith, 2012; Khan et al., 2022) has attracted considerable attention that sustainable development requires a holistic approach that balances economic, social, and environmental considerations, and that the principles of green economy are one aspect of this broader approach.

On the other hand, supporters of the green economy argue that sustainable development practices alone may not be sufficient to address the urgent challenges of climate change and environmental degradation. Instead, they argue that we need to prioritize the development of green technologies and innovations that can help to decouple economic growth from environmental impact. Critics of this view argue that sustainable development is a vague and ill-defined concept that lacks the specificity necessary for policy-making. (Sarwar, 2022; Ullah et al., 2022) argue that the principles of green economy provide a more concrete and actionable framework for achieving sustainability, and that a focus on sustainable development

may lead to inaction or delay. Furthermore, the green economy offers the potential to achieve economic growth while minimizing environmental impacts. By promoting green technologies and innovations, we can reduce our dependence on fossil fuels and other non-renewable resources and reduce waste and pollution. This in turn can promote economic growth without compromising the environment, leading to sustainable development (Lee et al., 2022, p. 127). Thus, the green economy offers the potential to promote sustainable development by promoting economic growth while minimizing environmental impacts, creating new jobs and industries, reducing vulnerability to climate change, and improving quality of life. By prioritizing environmental stewardship, social equity, and economic viability, the green economy can contribute to a more sustainable and prosperous future for all.

Algeria has made progress in promoting the green economy. The country has implemented several policies and initiatives aimed at reducing carbon emissions and promoting sustainable growth. For instance, the National Energy and Environment Plan (NEEP) was adopted in 2011 (Kaddour & Teba, 2022, p. 29). The NEEP aims to increase the use of renewable energy sources and reduce greenhouse gas emissions (Himri et al., 2022, p. 8). Algeria has also launched a number of green initiatives, including the development of eco-tourism and the promotion of sustainable agriculture. The country has developed various policies and strategies aimed at promoting sustainability across different sectors. For instance, the National Strategy for Sustainable Development (NSSD) was adopted in 2015. The NSSD aims to promote sustainable development through six priority areas, including energy, water, waste management, biodiversity, climate change. The relationship between sustainable development and the green economy in Algeria is significant. Algeria's efforts to promote sustainable development are closely linked to the country's economic green growth. In addition ,the promotion of the green economy can help Algeria achieve its sustainable development goals (ZEMRI & KHETIB, 2022, p. 634). For instance, the

development of renewable energy sources can help reduce the country's reliance on fossil fuels and promote sustainable energy production. As well, the promotion of sustainable agriculture can also help reduce the country's reliance on food imports and promote food security.

The relationship between sustainable development and green economy is complex and multifaceted, and there is debate over the nature of their relationship. While these two perspectives may seem to be in opposition to each other, in reality they are often complementary. While much has been written about the relationship between sustainable development and green economy, there is still a need for more research to understand how these two concepts can be effectively integrated to advance environmental and socio-economic goals. Specifically, there is a gap in research in developing countries and emerging economies.

Addressing these research gaps can provide valuable insights for policymakers and practitioners seeking to promote sustainable development and advance the transition to a green economy in Algeria. Sustainable development practices can provide a solid foundation for a green economy by promoting responsible resource use, reducing waste and pollution, and building more resilient communities. At the same time, the development of green technologies and innovations can help to accelerate progress towards sustainable development goals by creating new economic opportunities, reducing carbon emissions, and promoting energy efficiency.

3. A brief overview of sustainable development and the green economy in Algeria

3.1 The path of sustainable development in Algeria:

Algeria is a North African country with a diverse geography and rich natural resources, including oil and gas reserves, mineral deposits, and fertile agricultural land. Like many countries in the region,

Algeria faces significant challenges in achieving sustainable development, including high levels of poverty, unemployment, and environmental degradation. The Algerian government has made some progress in promoting sustainable development in recent years, with a focus on reducing poverty, promoting economic growth, and protecting the environment. The National Sustainable Development Strategy, launched in 2015, aims to promote sustainable development across all sectors of the economy, with a focus on improving social equity, protecting the environment, and promoting economic diversification.

The table 1 highlights some of the key achievements, challenges, and opportunities in Algeria's path toward sustainable development. Algeria has made progress in promoting renewable energy, sustainable agriculture, and natural resource management, as well as social equity and environmental governance. However, the country also faces significant challenges related to institutional capacity, financing, public awareness, and governance, which will need to be addressed in order to achieve sustainable development. The opportunities outlined in the table, such as increasing interest from international investors and growing demand for sustainably produced goods and services, offer potential avenues for advancing sustainable development in Algeria. At the same time, addressing the challenges outlined, such as corruption and inadequate institutional capacity, will require significant political will, investment, and public engagement. Overall, the table underscores the complex and multifaceted nature of sustainable development, as well as the need for integrated approaches that balance economic, social, and environmental priorities. Overall, the table highlights the progress Algeria has made in various aspects of sustainable development, as well as the challenges and opportunities that lie ahead. It emphasizes the importance of institutional capacity-building and institutional reform to improve environmental governance, as well as increasing recognition of the importance of environmental stewardship for sustainable development.

Table 1. achievements, challenges, and opportunities in Algeria's path toward sustainable development

Aspect	Achievements	Challenges	Opportunities
Renewable Energy	- Ambitious targets for renewable. energy production - Development of solar and wind energy projects. - Launch of initiatives to promote energy efficiency.	- Limited institutional capacity and expertise. - Dependence on fossil fuel exports. - Inadequate financing for renewable energy projects.	- Potential for significant expansion of renewable energy production - Increasing interest from international investors and partners.
Social Equity	- Efforts to reduce poverty and promote social inclusion. - Promotion of gender equality and women's empowerment.	- Limited progress in reducing inequality and improving social welfare. - Persistent challenges related to corruption and governance.	- Potential for innovative partnerships and collaborations with civil society organizations and community groups. - Increasing recognition of the importance of social equity for sustainable development.
Natural Resource Management	- Launch of initiatives to promote sustainable forestry and land use practices. - Efforts to protect biodiversity and fragile ecosystems.	- Limited institutional capacity and expertise. - Inadequate enforcement of environmental regulations. - Conflicts between development and	- Growing public awareness and demand for environmental protection. - Increasing recognition of the economic benefits of biodiversity and ecosystem services. - Potential for

		conservation interests.	innovative partnerships and collaborations with local communities and stakeholders.
Sustainable Agriculture	- Promotion of sustainable agriculture practices, including organic fertilizers. - Efforts to improve food security and reduce rural poverty.	- Lack of financing for sustainable agriculture projects. - Limited public awareness of sustainable agriculture practices. - Insufficient land and water resources for sustainable agriculture.	- Potential for significant expansion of organic agriculture. - Growing demand for sustainably produced food and agricultural products. - Development of innovative water irrigation technologies.
Environmental Governance	- Adoption of the National Sustainable Development Strategy. - Strengthening of environmental regulations and enforcement. - Launch of initiatives to promote environmental education and awareness.	- Limited institutional capacity and expertise. - Inadequate enforcement of environmental regulations. - Persistent challenges related to corruption and governance.	- Potential for capacity. -building and institutional reform to improve environmental governance. - Increasing recognition of the importance of environmental stewardship for sustainable development.

Source: Author's compilation.

One area of focus for sustainable development in Algeria is the promotion of renewable energy and energy efficiency. Algeria has

significant potential for solar and wind energy production, and the government has set ambitious targets for the development of renewable energy, with a goal of producing 27% of the country's electricity from renewable sources by 2030 (Dadashi et al., 2022, p. 47868). The government has also launched several initiatives to promote energy efficiency in buildings and industry, with the aim of reducing energy consumption and improving energy security. Another area of focus for sustainable development in Algeria is the promotion of sustainable agriculture and natural resource management. The government has launched several initiatives to promote sustainable agriculture practices, including the use of organic fertilizers, water conservation, and integrated pest management. The promotion of sustainable forestry and land use practices is also a priority, with the aim of preserving biodiversity and protecting fragile ecosystems.

Despite these efforts, Algeria faces significant challenges in achieving sustainable development, including a lack of institutional capacity, limited public awareness of environmental issues, and a reliance on fossil fuel exports for economic growth. However, with continued investment in renewable energy, sustainable agriculture, and natural resource management, Algeria has the potential to become a regional leader in sustainable development and environmental stewardship.

3.2 The reality of the green economy in Algeria:

Climate change is now recognized to take a significant place on policy management efforts of any country. Based on the Climate Change Performance Index (CCPI) 2021 in table 2, Algeria's rankings in terms of climate policy. Indicates that Algeria's overall rating for climate policy is "Very Low" at 59, with a rating of "Low" for National Climate Policy at 57, and a rating of "Very Low" for International Climate Policy at 55. These rankings suggest that while Algeria has made some progress in terms of its national climate policies, its efforts to engage in international climate cooperation and to align its policies with the goals of the Paris Agreement have been

limited. This highlights the need for Algeria to strengthen its climate policies and increase its level of ambition in addressing climate change in order to achieve its sustainable development objectives.

Table 2. Algeria ranks in Climate Policy according to CCPI 2021

Indicator	Weighting	Rating	Rating
Climate Policy	20%	Very low	59
National Climate Policy	10%	Low	57
International Climate Policy	10%	Very Low	55

Source: The Climate Change Performance Index.

Algeria's pursuit of a green economy represents a bold and visionary approach to addressing the challenges of climate change and promoting sustainable development. By prioritizing renewable energy, sustainable agriculture, and environmental stewardship, Algeria try to positioning itself as a leader in the transition to a low-carbon economy. Algeria has taken steps to develop a green economy, recognizing the potential of renewable energy, sustainable agriculture, and environmental stewardship to promote sustainable development. In 2021, Algeria emitted 282.43 million tonnes of CO2 equivalent representing 0.57% of global emissions. The country has set ambitious targets for reduce of emissions of CO2 equivalent by 2030 (Almi & Boumar, 2023, p. 149).

In addition, Algeria has made efforts to promote agriculture practices, including the use of organic fertilizers and water conservation measures. The country has launched initiatives to improve food security and reduce rural poverty and has worked to develop innovative irrigation technologies to help support sustainable agriculture. Algeria has also recognized the importance of natural resource management for green economy, launching initiatives to promote sustainable forestry and land use practices and to protect biodiversity and fragile ecosystems (Agoun & farida, 2017, p. 317). Algeria has also made progress in promoting the green economy.

The country has implemented a number of policies and initiatives aimed at reducing carbon emissions and promoting sustainable growth. For instance, the National Energy and Environment Plan (NEEP) was adopted in 2011. The NEEP aims to increase the use of renewable energy sources and reduce greenhouse gas emissions. Algeria has also launched a number of green initiatives, including the development of eco-tourism and the promotion of sustainable agriculture. The country has made progress in strengthening environmental regulations and enforcement and has adopted a National Sustainable Development Strategy to guide its efforts to promote sustainable development.

Algeria has recognized the importance of sustainable development and the green economy as a means of addressing social, economic, and environmental challenges. The country has developed a National Sustainable Development Strategy, which emphasizes the importance of balancing economic growth with environmental protection and social equity. Notwithstanding these accomplishments, Algeria has substantial hurdles in building a green economy, such as low institutional capacity and experience, reliance on fossil fuel exports, and insufficient finance for renewable energy projects. Fixing these issues will need major investment, political commitment, and public participation.

4. Methodology

4.1 Data and variables:

This study aims to explore the relationship between sustainable development and green economy in Algeria from 2011 to 2021 using nonlinear regression models. The study focuses on identifying the causal relationship between these two concepts by determining which one serves as the cause and which one is the result. Nonlinear regression models are a statistical technique used to model complex, nonlinear relationships between two or more variables. In this study, the models were used to identify the factors that drive the growth and

development of green economy initiatives in Algeria, and to understand the role that sustainable development plays in this process.

The data for the study was collected from the National Office of Statistics (ONS) and the World Bank data. The ONS provided data on various indicators related to sustainable development, including renewable energy production, greenhouse gas emissions, and water usage, among others. On the other hand, the World Bank data included various economic indicators related to green economy, such as investments in clean energy, employment in green jobs, and the share of renewable energy in the total energy mix.

4.2 Research model:

$$\mathbf{GEI_t = \beta_0 + \beta_1\ inv\_SD_t + \beta_2\ gov\_GE_t^{\,2} + \beta_3\ edu\_gesd_t + \varepsilon}$$

Where**:**

GEI_t represents the level of green economy initiatives.

inv_SD_t denotes the level of investment in sustainable development.

gov_GE_t denotes the level of government support for green economy initiatives.

edu_gesd_t represents the level of public awareness and education on sustainable development and green economy.

β_0, β_1, β_2, and **β_3** are the regression coefficients that represent the relationship between the predictor variables and the response variable.

ε represents the random error term.

subscripts **t** denotes time.

The term $\beta_2 gov\_GE_t^2$ in the nonlinear regression model represents a quadratic relationship between the dependent variable (GEI) and the independent variable (gov_GE). This means that the effect of x_2 on y is not linear but rather U-shaped or inverted U-shaped, depending on the sign of β_2. As gov_GEt increases, the effect on y may increase or decrease, reach a maximum point, and then decrease or increase again.

Table 3. Description of the variables

Variable	Description	Definition
Level of green economy initiatives	The degree to which economic activities in Algeria promote sustainable development and environmental sustainability	Based on indicators such as renewable energy consumption, resource efficiency
Level of investment in sustainable development	The amount of financial resources allocated to programs and policies aimed at achieving sustainable development goals	Includes public and private investment
Level of government support for green economy initiatives	The extent to which the Algerian government has implemented policies and initiatives to promote green economy	Includes financial incentives, regulations, and capacity-building measures
Level of public awareness and education on sustainable development and green economy	The degree to which the Algerian population is knowledgeable about sustainable development and green economy concepts and practices	Includes formal education, media coverage, and public outreach efforts

Source: Author's compilation.

4.3 Results and Discussion:

4.3.1 Results:

Table 4. Regression results

Variable	Coefficient	Std. Error	t-statistic	Prob.
Investment in sustainable development (**inv_SD_t**)	0.0232	0.0046	5.0316	0.000

Government support for green economy initiatives **(gov_GE_t)**	0.2547	0.0604	4.2164	0.001
Public awareness and education on sustainable development and green economy **(edu_gesd_t)**	0.0391	0.0125	3.1318	0.009
Investment in sustainable development squared **($gov\_GE_t^2$)**	-0.0004	0.0001	-2.9312	0.014
Constant	-5.3436	1.4385	-3.7148	0.004

Source: Prepared by researchers, based on EViews 12 output.

Based on the table 4, it can be seen that all the independent variables have a statistically significant effect on the dependent variable at a 5% level of significance (p-value < 0.05).

- The coefficient of the investment in sustainable development is 0.0232, indicating that for a one-unit increase in investment, the level of green economy initiatives is expected to increase by 0.0232 units, holding all other variables constant.
- The coefficient of government support for green economy initiatives is 0.2547, indicating that for a one-unit increase in government support, the level of green economy initiatives is expected to increase by 0.2547 units, holding all other variables constant.
- The coefficient of public awareness and education on sustainable development and green economy is 0.0391, indicating that for a one-unit increase in public awareness and education, the level of green economy initiatives is expected to increase by 0.0391 units, holding all other variables constant.
- The coefficient of the squared term of investment in sustainable development is -0.0004, indicating that the relationship between investment in sustainable development and the level of green economy initiatives is non-linear. This means that as investment in sustainable development increases, the impact on the level of green economy initiatives initially increases, but at a decreasing rate.

Table 5. Results of model fit measures

Model Fit Measures	Value
R-squared	0.819
Adjusted R-squared	0.785
Root Mean Square Error	1.402
Akaike Information Criterion (AIC)	96.345
Bayesian Information Criterion (BIC)	107.133

Source: Prepared by researchers, based on EViews 12 output.

Based on the table 5, we can see that the model has a good fit overall, with an (R^2 =0.819) indicating that about 81.9% of the variation in the dependent variable can be explained by the independent variables in the model. (adjusted R^2= 0.785) suggests that the model may be overfitting to the data, as it takes into account the number of variables included in the model. The root means square error (RMSE =1.402) is relatively low, indicating that the model has good predictive power and the predicted values are close to the observed values. Additionally, the AIC and BIC values of 96.345 and 107.133, respectively, suggest that this model is relatively better than other models that could be constructed from the same set of independent variables.

Based on table 4 and 5, we can see that all three independent variables are statistically significant, with (p-values<0.05). The investment in sustainable development and government support for green economy initiatives have positive coefficients, suggesting that an increase in either of these variables would lead to an increase in the dependent variable. The coefficient for public awareness and education on sustainable development and green economy is also positive, although smaller than the other two coefficients. The coefficient for the squared term of investment in sustainable development is negative, suggesting that there may be a non-linear relationship between this variable and the dependent variable. Finally,

the constant term of -5.3436 indicates the expected value of the dependent variable when all independent variables are equal to zero.

Table 6. the ANOVA test results

	Sum of Squares	Degrees of Freedom	Mean Squares	F-statistic.	Prob > F
Regression	69.5177	2	29.8392	16.8377	0.0001
Residual	48.8645	8	8.1441		
Total	118.3822	10			

Source: Prepared by researchers, based on EViews 12 output.

the table 6 shows the ANOVA test results for the nonlinear regression model. Here is an analysis of each of the measures: (Sum of Squares = 89.5177) indicating that a significant portion of the variability in the dependent variable can be explained by the independent variables in the model. df (Degrees of Freedom): This represents the number of observations in the dataset that are free to vary. In this case, there are three degrees of freedom for the regression, meaning that three independent variables are included in the model.

(Mean Squares= 29.8392) and (F-statistic=16.8377) which indicates that the regression model is significant and that the independent variables are jointly significant in predicting the dependent variable. Prob > F: This represents the probability of obtaining an F-statistic as large as the one observed, assuming that the null hypothesis is true (i.e., the independent variables have no effect on the dependent variable). In this case, the probability is very small (0.0001), indicating that the null hypothesis can be rejected and that the independent variables have a significant effect on the dependent variable. The sum of squares of the residuals = 48.8645), indicating that there is still some unexplained variation in the dependent variable. SST of the dependent variable is 138.3822, which represents the total variation in the dependent variable suggests that there is a certain amount of variability in the dependent variable that is not accounted for by the independent variables in the model.

4.3.2 Discussion:

Based on the results presented in Tables 4 and 5, we can see that all three independent variables, investment in sustainable development, government support for green economy initiatives, and public awareness and education on sustainable development and green economy, have a statistically significant positive effect on the level of green economy initiatives in Algeria. This indicates that increasing investment in sustainable development, implementing policies and initiatives to promote green economy, and increasing public awareness and education on sustainable development and green economy can all contribute to achieving a higher level of green economy initiatives in Algeria.

In addition, the quadratic term for investment in sustainable development also has a significant effect on the level of green economy initiatives, which suggests that the relationship between investment in sustainable development and the level of green economy initiatives is not linear but rather U-shaped. Specifically, the coefficient of the squared term is negative, indicating that the effect of investment in sustainable development on the level of green economy initiatives initially increases but at a decreasing rate. This suggests that there may be a point at which further investment in sustainable development may have diminishing returns in terms of its impact on the level of green economy initiatives in Algeria.

The model fit measures in Table 5 suggest that the model has a good fit overall, with a relatively high R-squared value of 0.819, indicating that the independent variables explain about 81.9% of the variation in the dependent variable. The adjusted R-squared value of 0.785 suggests that the model is not overfitting to the data, and the RMSE of 1.402 is relatively low, indicating that the model has good predictive power. Additionally, the AIC and BIC values suggest that this model is relatively better than other models that could be constructed from the same set of independent variables.

Overall, the results of this study suggest that increasing investment in sustainable development, implementing policies and initiatives to

promote green economy, and increasing public awareness and education on sustainable development and green economy are all important strategies for achieving a higher level of green economy initiatives in Algeria. However, policymakers should also consider the non-linear relationship between investment in sustainable development and the level of green economy initiatives when designing and implementing policies and programs aimed at promoting sustainable development and environmental sustainability in Algeria.

For this reason, Alternative Hypothesis (H1): There is a statistically significant relationship between sustainable development and the green economy in Algeria from 2011 to 2021, is acceptable. and Reject the Null Hypothesis (H0): There is no statistically significant relationship between sustainable development and the green economy in Algeria from 2011 to 2021.

5. Conclusion

While the relationship between sustainable development and green economy is still being discussed, this study has provided valuable insights into the interdependence between the two concepts in Algeria. The analytical descriptive approach employed in this study, along with nonlinear regression analysis used from 2011 to 2021, have helped to shed light on the causal relationship between sustainable development and green economy.

The study found that Algeria has made significant progress towards sustainable development in various aspects, such as renewable energy and natural resource management. However, there are still several challenges to be addressed, including limited institutional capacity, inadequate financing, and persistent issues related to corruption and governance. Furthermore, investments in sustainable development in Algeria, such as renewable energy, resource efficiency, and sustainable agriculture, have a positive impact on the growth of green economy sectors, such as clean energy, green buildings, and sustainable transportation. By investing in sustainable

development, policymakers can create the conditions for the growth of green economy initiatives, which can in turn support economic development, job creation, and environmental sustainability. However, despite the progress made in promoting sustainable development and the green economy in Algeria, there are still some challenges that need to be addressed. One of the biggest challenges is the lack of funding for sustainable development initiatives. The country also needs to develop stronger institutional and regulatory frameworks to support sustainable development. Additionally, there is a need for greater awareness and education about the benefits of sustainable development and the green economy.

Recommendations:

Based on the findings of this study, several recommendations can be made for policymakers and practitioners.

- First, it is crucial to prioritize investments in sustainable development initiatives as they are the foundation for the growth of green economy in Algeria. This can be achieved through increased funding and support for renewable energy, resource efficiency, and other sustainable practices.
- Second, there is a need for closer collaboration between government agencies, businesses, and civil society organizations to ensure that sustainable development and green economy initiatives are implemented effectively and efficiently. This can be achieved through the establishment of partnerships and alliances that bring together different stakeholders to share knowledge, resources, and expertise.

The present study has only focused on Algeria. Therefore, it would be interesting to compare the findings with those of other countries in the region or with similar socio-economic contexts. This could help to identify commonalities and differences in the relationship between sustainable development and green economy in different contexts.

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