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Greenhouse Gas Control and Sustainable Economic Development: An Environmental Impacts Analysis

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Abstract: Green House Gases change the climate by trapping heat. Normally, these gasses increase air pollution and affect the respiratory system of humans. The largest emitter of greenhouse gases is the energy sector. The significant sources of Green House Gas include the Transportation Industry (especially Construction & Mining, and agriculture). An example of Green Gas is that agriculture produces methane while burning fossil fuels releases carbon dioxide. We have pre-determined that the carbon dioxide warming effect helps to stabilize the earth's atmosphere; life on earth is possible due to the greenhouse effect. Without it, the earth's surface would be around -19°C instead of the current average of 14°C. The greenhouse effect is produced by greenhouse gasses (GHG) like water vapour, carbon dioxide (CO2), methane (CH4), nitrous oxides (NxO) and ozone (O3). GHG has natural and anthropogenic origins. However, increasing GHG emissions to a large extent will impact climate change, leading to affected production. This study analyzes the negative impact on production, which will slow down business activities and, in turn, impact repayment capability. This results in a higher defaulting ratio. A structural equation model was developed to understand the interrelationship between these exogenous and endogenous variables.

Keywords: Greenhouse Gas (GHG); Global Warming; Pollution and Carbon Dioxide; Data Processing and Analysis Plan; Environmental Impacts Analysis; Respiratory System of Humans; Global Climate Change.

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1. Introduction

The topic of greenhouse gas emissions and their effects on the environment has attracted substantial attention on a global scale in recent decades. Concerns about climate change and its negative consequences on ecosystems, human health, and the long-term viability of economic growth have arisen due to the rise in these emissions, mostly attributable to human activity. As a result, academics and politicians are actively looking at ways to reduce greenhouse gas emissions while fostering sustainable economic growth. Energy efficiency and adopting eco-friendly practices have become crucial to limiting greenhouse gas emissions and maintaining sustainable economic growth. Several studies have studied the relationship between energy use, technological advancement, commerce, and environmental sustainability. In order to create successful policies and programmes

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that fulfil the dual goals of economic growth and environmental protection, it is essential to comprehend the intricate interplay between these issues [7].

The agriculture industry's development of greenhouse crops is one area that has drawn a lot of interest. In Tehran Province, Iran, Ahmadbeyki et al. [1] performed a thorough investigation comparing the energy consumption effectiveness and environmental effects of cucumber and tomato crops. According to their research, tomato cultivation uses energy more effectively than cucumber production. The research also emphasized the need for greenhouse systems that use less energy and less chemical fertilizer to achieve sustainable output.

Another area that merits consideration is the building industry, which is well-recognized for its enormous contributions to greenhouse gas emissions. The use of environmentally friendly construction materials, such as hemp-lime concrete, which not only has little embodied environmental effects but also captures carbon dioxide from the atmosphere, was emphasized by Bošković and Radivojević [2]. Their study emphasized the need to examine the greenhouse gas emissions produced by these materials throughout their lifetimes and the effects of numerous variables, such as construction waste and transportation distances.

The connection between energy efficiency, technical innovation, trade, and environmental quality has been studied on a larger scale in addition to individual industries. In 10 Asian economies, Wenlong et al. [3] examined how these factors affected the environment. Their research showed that institutional quality and trade openness negatively affected environmental quality, but energy efficiency and technical advancements had positive consequences. These results highlight how crucial it is to invest in technology, raise institutional quality, and enact trade-related environmental policies to achieve sustainable environmental outcomes in Asian nations.

Ahmad et al. [4] have also investigated the dynamic interaction between natural resources, technological advancements, economic growth, and ecological footprint. Their study clarified the necessity for suitable policy development to enable sustainable economic development, accelerate technical innovation, and restore natural resources.

On top of that, the investigation by Akdag and Yildirim [5] into the connection between energy efficiency and greenhouse gas emissions was primarily directed at European nations. The results showed a long-term relationship between lower emissions and energy efficiency, highlighting the need to implement policies that increase energy efficiency for sustainable development. Al-Mulali and Sheau-Ting [6] investigated the connection between commerce, energy use, and CO2 emissions across several locations. Their findings showed that trade factors had long-term beneficial links with energy usage and CO2 emissions. Depending on a country's degree of development and the GDP contribution to trade, the importance of this connection changes [8].

These studies make it clear that solving climate change issues and attaining environmental sustainability depends on understanding the relationship between reducing greenhouse gas emissions and sustainable economic growth. The current study aims to add to this expanding body of knowledge by thoroughly examining how greenhouse gas management strategies affect economic growth [9]. This research attempts to offer useful insights and policy recommendations for striking a sustainable balance between economic growth and environmental conservation by reviewing the experiences and findings from diverse studies [10].

This study will highlight the significance of enacting trade-related environmental rules, stimulating technical innovation, adopting energy-efficient practices, and enhancing institutional quality to foster sustainable economic development and greenhouse gas reduction [11]. Policymakers can address climate change issues and secure a sustainable future for future generations by taking action and recognizing the critical variables and interactions that affect environmental sustainability.

2. Review of Literature

An investigation by Ahmadbeyki et al. [1]. from 2023 was named "Energy use and environmental impacts analysis of greenhouse crops production using life cycle assessment approach: A case study of cucumber and tomato from Tehran province, Iran." Their study especially compared cucumber and tomato crops to investigate the greenhouse crop production's energy consumption effectiveness and environmental effects. The results show tomato production has a greater energy usage efficiency (0.55) than cucumber production (0.26). Notably, over 60% of the energy inputs are made up of diesel fuel usage. Cucumbers and tomatoes, each releasing 18,836.81 and 338.28 kg of carbon dioxide, are cited as a serious environmental problem. The study emphasizes the significance of developing greenhouse systems that use less energy and rely less on chemical fertilizers to achieve sustainable output. The study's findings imply that tomato cultivation uses less energy and negatively impacts the environment less than cucumber production.

Bošković & Radivojević [2] note in their analysis that the construction sector greatly influences This study focuses on hemp-lime concrete as a bio-based substance that can absorb CO2 and utilize renewable resources. The study examines fluctuations throughout its life cycle and uses life cycle assessment techniques to analyse the greenhouse gas emissions linked to hemp-lime concrete walls. According to the study, construction waste, carbonation of binder, carbonation of hemp shiv, and transport distances all significantly impact emissions. The findings demonstrate both optimistic and pessimistic scenarios, with the former having a negative impact on global warming and the latter having a beneficial impact. Alternative end-of-life scenarios demonstrate how hemp shiv's capacity to degrade affects greenhouse gas emissions.

Wenlong, Z. et al. [3] investigated the effects of institutional quality, trade openness, and technological advancements on the environment in 10 Asian economies from 1995 to 2018. The study indicates that while energy efficiency and technological advancements have favourable effects on environmental quality, trade openness and institutional quality have negative effects. The empirical findings imply that for Asian countries to attain sustainable and enhanced environmental quality, they should prioritise improving institutional quality, investing in technological advances, and putting trade-related environmental legislation and energy efficiency measures into place. Overall, this study offers insightful information for decision-makers worried about environmental sustainability and the long-term stability of economic development in Asian nations.

Ahmad et al. [4] validate a long-term link between these factors using data from 1984 to 2016 and panel co-integration techniques. The findings show that while technical advancements aid in reducing environmental degradation, natural resources and economic expansion contribute to an increase in the ecological footprint. The Environment Kuznets Curve indicates that economic progress has a detrimental effect on the ecological imprint. In order to achieve the study's goals for sustainable development, it is crucial to put in place the right policies to support technical advancements and restore natural resources.

Akdag and Yildirim [5] examine the connection between energy efficiency and greenhouse gas emissions in 29 European nations from 1995 to 2016. It discovers a long-term link between energy efficiency and greenhouse gas emissions, with improved efficiency leading to lower emissions, using panel co-integration, panel causality, FMOLS, and DOLS analysis. The new methodology of the study supports a causal link between energy efficiency and greenhouse gas emissions. For European nations to create effective policies to increase energy efficiency and decrease greenhouse gas emissions, which support environmental sustainability, they need to consider these findings.

Al-Mulali & Sheau-Ting [6] conducted an Economic analysis of trade, exports, imports, energy consumption and CO2 emission in six regions. In 189 nations spread over six distinct areas, the study looks into the connection between commerce, energy use, and CO2 emissions. The results show trade factors have long-term positive relationships with most locations' energy consumption and CO2 emissions. At the national level, this link is more prominent in nations with greater levels of development and a significant trade-to-GDP ratio. The association is either negative or insignificant in nations with early stages of development and limited trade contributions to GDP. These findings offer important new perspectives on the intricate relationships between commerce, energy use, and CO2 emissions at the international and national levels.

3. Objectives

- To ascertain the factors responsible for GHG emissions and its impact on climate change
- To assess the ways to curtail the GHG emission
- To establish the link between reduced GHG emissions and increased economic sustainability.

3.1. Hypothesis

- H01: The correlation matrix is an identity matrix.
- H02: The RE procurement cost will not induce industries to resort to coil, oil and gas energy sources
- H03: The perception about GHG emission and climate change is the same across the positions occupied by the respondents
- H04: The different ways to reduce GHG emissions will not induce economic growth

4. Research design

The structure of the entire research is listed below.

Research methodology: Empirical research was conducted to determine the perception of the intrapreneurial perspective.

Sources of data: Primary research was conducted to collect responses from respondents across different age groups and educational backgrounds.

Sampling plan: 114 respondents were interviewed to know their perception of the impact of different factors on the increasing default rate. These respondents were from different educational backgrounds.

Data collection instruments: A Questionnaire was developed to analyze the responses of these entrepreneurs. Different parameters were developed to know their perception.

Data processing and analysis plan: Different statistical analyses were applied to analyze the respondents' responses. For the study, the following tests were applied:

- Regression analysis
- ANOVA
- Structural Equation Model

5. Data Analysis

Only 114 respondents were interviewed. In order to give the scope, only Carbon gas emissions are taken into consideration to prove the duration of the study through regression; many other factors are not considered, so the current study gives only limited scope. Time is another constraint that limits the scope because, in the long run, the project stocking must be maintained.

The study was undertaken to determine GHG gas emissions' influence on ecology and the nation's growth. Hypotheses were developed, and multiple statistical tests were undertaken. Various parameters were developed to study the impact of GHG emissions on economic growth [12]. Factor analysis was conducted to reduce the dimensions and group them into main categories. To conduct the factor analysis to know the adequacy of the sample, the KMO SA test was conducted.

H01: The correlation matrix is an identity matrix.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.844**
Bartlett's Test of Sphericity	Approx. Chi-Square	**2947.366**
	df	**136**
	Sig.	**.000**

The test result of KMO SA is 0.844, which is sufficiently large to proceed further with the factor analysis (Table 1). The significant value is less than 5%, through which the null hypothesis was rejected. It was concluded that variables are related and can be grouped into different dimensions, and the data is ideal for factor analysis [13].

5.1. Factor analysis

Table 2: Rotated Component Matrix[a]

	Component		
	1	**2**	**3**
Coil, Oil, and Gas industries are responsible for high GHG emissions.		**.917**	
The automobile sector also contributes to the same.		**.983**	
Reduced carbon emissions will result in a sustainable business model.		**.916**	
Higher HGH emissions result in climate change.		**.895**	
Climate change results in slower economic progress		**.971**	
slower economic progress results in increasing default payments		**.942**	

Cap and trade system will reduce GHG emission	**.858**		
There is a need for a global effort to achieve NET ZERO	**.880**		
Purchase solar panels	**.955**		
Purchase carbon offsets	**.875**		
Install solar lights	**.903**		
Buy green tags	**.882**		
Reduce, Reuse, Repair and Recycle	**.871**		
Reduced GHG improves the economic condition.			**.961**
This reduces the number of defaulters.			**.927**
Reduced GHG will speed up the recovery process.			**.954**
A good recovery process will induce increased lending and result in higher lending activities.			**.955**
Extraction Method: Principal Component Analysis. *Rotation Method: Varimax with Kaiser Normalization.* *a. Rotation converged in 4 iterations.*			

The parameters above are grouped into three categories from the above-rotated component matrix (Table 2). They were further named as below:

Component 1: Ways to reduce GHG emissions
Component 2: Factors responsible for GHG emissions
Component 3: Reduced GHG results in improved Economic growth

These components are further tested with the help of various statistical tools.

H02: The RE procurement cost will not induce industries to resort to coil, oil and gas energy sources.

Table 3: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**.931[a]**	**.867**	**.866**	**.6339**
a. Predictors: (Constant), The procurement cost of RE compels industries to resort to coal, oil, and gas energy resources				
b. Dependent Variable: Coil, Oil and Gas industries are responsible for high GHG emission				

The study was conducted to determine whether the cost of procuring renewable energy will induce industries to resort to other energy sources [14]. A regression analysis was conducted on the same (Table 3). The R2 explains an influence of 86.7%, sufficiently large enough to say that high procurement costs result in procuring other energy sources. To determine the relationship between these two, the coefficients in Table 4 are analyzed.

Table 4: Coefficients[a]

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	**.135**	**.129**		**1.047**	**.297**
	The procurement cost of RE compels industries to resort to coil, oil and gas energy resources	**.941**	**.035**	**.931**	**27.156**	**.000**
a. Dependent Variable: Coal, Oil and Gas industries are responsible for high GHG emission						

From Table 4 above, a regression equation is formed with the help of Beta coefficients.

Procuring coal, oil, and gas sources (Is depending on) = 0.135 + 0.941 * RE Procurement cost

An ANOVA test was conducted to determine the significance of the impact.

Table 5: ANOVA

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	**296.285**	**1**	**296.285**	**737.423**	**.000**[b]
	Residual	**45.402**	**113**	**.402**		
	Total	**341.687**	**114**			

a. Dependent Variable: Coil, Oil and Gas industries are responsible for high GHG emissions
b. Predictors: (Constant) The procurement cost of RE compels industries to resort to coal, oil, and gas energy resources

The ANOVA test was conducted to know the significance of the impact of the predictor variable on the DV (Table 5). The significant value of less than 5% explains that IV significantly impacts DV. Hence, the null hypothesis was rejected, and it was concluded that the procurement cost of RE will induce industries to procure other energy sources, which may result in higher GHG emissions.

H03: The perception about GHG emission and climate change is the same across the positions occupied by the respondents

An ANOVA test was conducted to determine whether there was any difference in the respondents' perceptions depending on their position (Table 6).

Table 6: Higher GHG emissions result in climate change

Higher GHG emissions result in climate change.					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	**15.542**	**6**	**2.590**	**.731**	**.625**
Within Groups	**382.544**	**108**	**3.542**		
Total	**398.087**	**114**			

The low F-value and high significant value signify no difference in the respondents' perception across the positions they occupy. Hence, we failed to reject the null hypothesis.

H04: The different ways to reduce GHG emissions will not induce economic growth

Table 7: Different ways to reduce GHG emissions not induce economic growth

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**.877**[a]	**.769**	**.767**	**.54973**
a. Predictors: (Constant), Ways_To_Reduce_GHG_Emission				
b. Dependent Variable: Reduced_GHG_Emission_Increased_Eco_Growth				

Multiple ways are available for GHG emissions reduction (Table 7). The different ways adopted may boost economic activities. Higher emissions will result in climate change, which impacts business activities and will further impact repayment capacity.

A regression analysis determined whether reduced GHG emissions will boost economic growth. R2 is large enough to say IV has a higher impact (0.769) on the DV. To determine the significance of the impact, the ANOVA test was conducted (Table 8).

Table 8: The significance of the impact of the ANOVA test

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	**113.585**	**1**	**113.585**	**375.851**	**.000**[b]
	Residual	**34.149**	**113**	**.302**		
	Total	**147.735**	**114**			
a. Dependent Variable: Reduced_GHG_Emission_Increased_Eco_Growth						
b. Predictors: (Constant), Ways_To_Reduce_GHG_Emission						

The significant value was less than 5%, so the null hypothesis was rejected, stating that reducing GHG emissions would boost economic growth.

To a large extent, GHG emissions will impact climate change, affecting production. The negative impact on production will slow down business activities, which, in turn, will impact repayment capability. This results in a higher defaulting ratio. A structural equation model was developed to understand the interrelationship between these exogenous and endogenous variables.

5.2. Structural Equation Model

A regression model was used as there was no latent variable. Figure 1 shows endogenous and exogenous variables. GHG emissions, climate change and Affected production, are taken as exogenous variables, and reduced profits are endogenous variables for the above three and act as the independent variable for Defaults in payments.

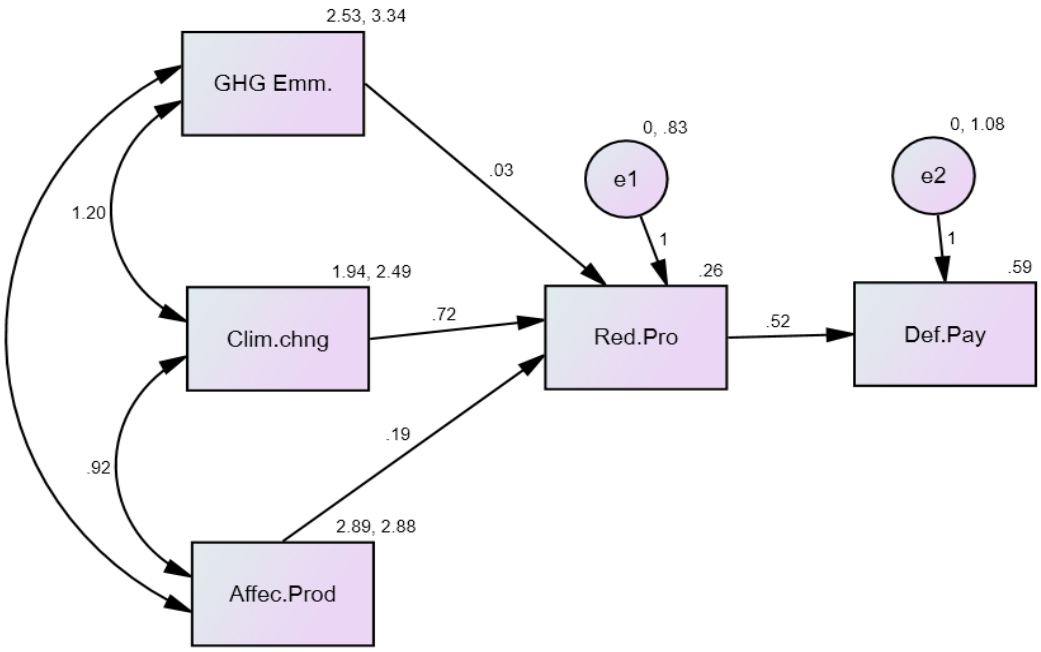

Figure 1: Regression model showing analysis result

The regression weight in Table 9 below shows the S.E and critical ratio. Climate change, affected production, and reduced profits show significant value, less than 5%.

Table 9: Regression Weights and Standardized Regression Weights

			Estimate	S.E.	C.R.	P	Estimate
Red.Pro	<---	GHG_Emm	.028	.055	.508	.612	.032
Red.Pro	<---	Clim.chng	.724	.061	11.970	***	.713
Red.Pro	<---	Affec.Prod	.195	.057	3.418	***	.206
Def. Pay	<---	Red.Pro	.518	.061	8.566	***	.625

This means it has the strongest ability to predict the reduction in production; GHG emission has the highest p-value, i.e.,0.612, which has the weakest ability to predict carbon emission. The impact of GHG emissions on reduced production is not established with a high P-value.

6. Findings of the study

The study was conducted to determine the impact of GHG emissions on climate change, which might result in loan defaulters. Multiple hypotheses were developed to determine the impact of these variables on loan repayment capacity. Various parameters were developed to understand the perception of respondents. A factor reduction technique was used to group these parameters into different dimensions. The KMO SA test was conducted to proceed with factor analysis. Since the test results were sufficiently high, it was considered a sample sufficient to proceed with Factor analysis. The correlation between the variables was considered to group these variables into different dimensions. Three dimensions were identified: Ways to reduce GHG emissions, Factors responsible for GHG emissions, and Reduced GHG results in improved economic growth. These dimensions were further analyzed using various statistical techniques.

A hypothesis was developed to determine whether the cost of RE procurement will induce industries to resort to coal, oil, and gas energy sources. Regression analysis was conducted for the same. The higher R2 and significant value of less than five per cent explained a significant impact of procurement cost (IV) on types and sources of energy procurement.

A hypothesis was developed to know if the perception of GHG emission and climate change is the same across the positions occupied by the respondents. An ANOVA test was conducted to assess whether there was any difference in the respondents' perceptions. The significant value being greater, it was concluded that there is no difference in the perception across the position occupied.

Another hypothesis was developed to know whether GHG emissions will induce economic growth. Regression analysis was conducted for the same. The R-squared value and significant value explained the significant impact of reduced GHG emissions on increased economic growth, but the null hypothesis was rejected.

GHG emissions will affect the environment. This results in climate change, which further impacts production activities. This will impact the repayment capability. An SEM model was developed for the same. The direct impact of GHG emissions on reduced productivity was not established since the significant value was high. However, the direct impact was established with all other variables, with the significant value being less than five percent.

7. Conclusion

Greenhouse gas emissions affect the natural environment. The study was deeply analyzed with limited variable consideration of 115 respondents. The Sem model was developed the same way to give the result due to the emission of carbon dioxide's significant level of less than five percent because it has never reduced productivity. Usually, emissions in industry involve using materials more efficiently. Emissions are saved; in industry, solar power infrastructure has been developed to reduce the cost of electricity consumption. Like China, India has to develop charging stations where solar power transmits electricity, at least in high ways, increasing the purchase of electronic vehicles. This will not only reduce fuel costs but also reduce environmental pollution. The study was conducted to determine whether the cost of renewable energy procurement will induce industries to resort to other energy sources. Regression analysis was conducted for the same. The R2 explains an influence of 86.7%, sufficiently large enough to say that high procurement costs result in procuring other energy sources. The Paris Agreement on Climate Change is important, and we should all work together to make it successful.

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Ethics and Consent Statement: This research adheres to ethical guidelines and the importance of ESG in obtaining informed consent from all participants. Confidentiality measures were implemented to safeguard participant privacy.

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