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| RESEARCH ARTICLE

Climate Change and its Effects in the Rice Industry of the Philippines

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| ABSTRACT
Philippines' rice production consists of 20% of the gross value added of Philippine agriculture. The absence of the variable may bring drastic changes to the overall Philippine GDP; the research paper will determine whether climate change brings much harm to the Philippines' rice production industry. Due to pollution and with more companies that seek natural resources, climate change has become more severe. The data collected ranges from 1988-to 2017, and all the data gathered came from credible sources. The data collected were regressed using the Eviews as the medium, and the results were interpreted by the researchers. The result of the research proves that carbon emissions and rice production have a significant relationship and that one affects the other greatly.

| KEYWORDS
Climate Change; Rice Industry; Food and Agriculture Organization; Philippines

| ARTICLE DOI: 10.32996/jefas.2022.4.1.39

1. Introduction

1.1 Background of the Study

According to the Food and Agriculture Organization (FAO), the Philippines is the world's 8th largest exporter, accounting for 2.8% of the total rice production in the world in 2020. According to the Food and Agriculture Organization (FAO). Each year, we are beginning to experience the aftermath of our actions because we have not been taking good care of the place we live in and are slowly reaping the consequences of our efforts. One industry that should be highly aware of the state of the climate and what it brings is the rice industry. The rice industry is the staple of most Asian countries when it comes to nutrients because rice provides a decent amount of fiber, protein, vitamin B, and iron. This means that it plays a vital role in nutrition to combat malnutrition, which is one of the biggest problems in the world. Moreover, it is also critical to understand the country's economic growth, considering that the Philippines has established its role to be one of the leading rice producers across the world. However, there have also been lapses in sustainability in addressing the need to mitigate the effects of climate change and its possible consequences on the rice industry.

The global warming phenomenon has brought unprecedented challenges in the rice industry of the Philippines, rice being the vital source of nutrients for most Asians, especially Filipinos. The impact of climate change on the environment, Philippine economy, and society has instilled fear amongst Filipinos. As the Philippine economy continues to rise and achieve its goal of becoming the number one economy in the ASEAN region, natural resources are expended. The drive for economic growth in Asia, especially the Philippines, brought numerous opportunities to the Filipinos. As the productivity of the nation increases, it is understood that millions of Filipinos have moved from rural places to urban areas.

With this, the population in the urban areas is rapidly increasing, and this brings about several challenges such as noise pollution, overpopulation, and the most evident waste pollution. Economically speaking, this is beneficial for the country as it increases productivity and economic activity. However, that would not have been possible without consuming resources, and it is evident that the Philippines have been extracting these resources in ways that are not sustainable.

1.2 Statement of the Problem

Rice is the Philippines' most important staple crop. It accounts for 20% of the GVA of Philippine agriculture (Department of Agriculture, 2020). According to the World Economic Forum, total rice yield may drop 40% by 2100, bringing devastating consequences as rice is one of the world's basic food sources. By 2100, when climate change will take its toll, more than 2 billion people will not meet the required calories the body needs (Fendorf, 2019). Climate change is happening worldwide, and materials and products are certainly affected by it. Rice is one of the Philippines' products, though many more nations produce the said product in Asia.

This study aims to determine how much climate change affected total rice production in the Philippines. Furthermore, the authors would also like to define the steps the rice industry needs to take to avoid future dilemmas that climate change might cause.

The authors will be using Philippine rice production as the dependent variable, while greenhouse gas, rate of urbanization, and the country's agriculture GDP as independent variables. To answer the question, how does climate change affect rice production in the Philippines?

1.3 Research Objectives

1.3.1 Main Objective:

This study is crucial to determine how climate change affects rice production in the Philippines to explain the current situation. The researchers aim to present and explain the data studied to local farming groups and communities for them to understand what is happening and to adapt to the harm and possibilities that climate change may cause.

1.3.2 Specific Objectives:

1. To determine the steps the rice industry needs to take to avoid future dilemmas climate change might cause.
2. To identify the relationship between climate change and the overall production of rice in the Philippines.

1.4 Formulation of Hypothesis

This study aims to understand how carbon emissions have affected the Philippines ' rice industry regarding its production rate and its total contribution to the Philippines' GDP throughout the years. Also, to determine whether or not the relationship between the four-variable is significant, the researchers used multiple regression analysis. With that, the hypothesis of this study would be:

1.4.1 Hypothesis

Null Hypothesis (Ho): There is no significant relationship between urban population, carbon emissions, Philippine GDP, and the rice yield in the Philippines.

Alternative Hypothesis (Ha): There is a significant relationship between urban population, carbon emissions, Philippine GDP, and the rice yield in the Philippines.

1.5 Significance of the Study

The Philippines is ranked 13th as one of the biggest economies in Asia and ranked 29th in the world. The Philippines has been consistent in economic growth, but the said growth comes with a cost. The study will be conducted to assess the impact of climate change in the rice industry since the Philippines is the world's 8th largest producer of rice.

1.6 Scope and Limitations of the Study

The study is limited to thirty (30) observations dating 1988-2017, and the data collected is centered on the Philippines only. This study will occur from the second semester of the University of Santo Tomas' Academic Year 2020-2021 carrying it along until the first and second semester of Academic Year 2021-2022.

2. Review of Related Literature

2.1 CO2 Emissions and its Impact in the Rice Industry

Developing countries contribute to almost 75% of the total direct greenhouse gases emission and is still expected to rise in the upcoming years. With that being said, developing countries are not sleeping on it, as they have begun solving the said issues. Countries in the African continent have targeted their agricultural sector to reduce the emission of carbon footprints. Rice production intensification is essential, considering the critical role it plays in feeding the world's growing populations. For Ghana, where rice is a staple, a deficit in production has necessitated the intensification of rice production. Intensification of production, however, inevitably comes with a surge in GHG emissions.

Farag et al. and Kaba (2021) used a qualitative approach deploying surveys and observations to investigate further the effects of climate change on rice production in Ghana. On the other hand, energy is consumed mainly by residents and enterprises, and the CO2 emitted from industries account for a considerable proportion of energy-related CO2 emission.

In the same context, Yurtkuran (2021) examined the impact of agriculture on Carbon Dioxide (CO2) emissions in Turkey, and it revealed that agriculture has a positive effect on CO2 emissions, specifically at 1.516%. The study also revealed that the agricultural sector has contributed to fossil fuel consumption which had a relative effect on the recurring impact on CO2 emissions.

Saravia-Matus et al. (2019) evaluated the agricultural carbon emissions' performances of countries in Latin America and the Caribbean using the elasticity of Greenhouse gas emissions to the farm production index. Results portrayed that factor productivity performance was not always the best in the top 25% of countries with the best carbon emissions' performance (strong decoupling), so the environmental policy of promoting sustainable agricultural development played a crucial role in agricultural production.

Xu and Lin (2017) compared and analyzed the different factors contributing to the rise of GHG emissions from China's agricultural industry. The results showed that as CO2 emissions rise, GDP increases at the same rate. This proves that the relationship between CO2 emission and economic growth is positively correlated.

He et al. (2019) concluded that high temperatures would significantly affect rice production because the maximum heat stress threshold that rice could handle will cause the crop to die. This makes anthers challenging to solve but will eventually alter the processes of fertilization and pollination. Excessive heat will lead to reduced seed setting rate, grain mass, and seed weight. If rainfall occurs less in a year than expected, it will substantially decrease the stomatal conductance and intercellular CO2 flux, which prohibits rice from following its regular cycle of photosynthesis. This restricts rice from gathering peak nutrients, and respiration consumption will increase oppositely.

Stuecker et al. (2018) utilized standard correlation analysis to understand further the relationship between three variables: climate change, rice production, and yield. To expound on the relationship of the variables, the authors utilized a sample size of 30 and separated seasonal anomalies to be independent of irregularities in the same season of the previous and following years. In some areas, adjustments of the cropping sequence will be necessary to match the changing ecosystem boundaries. Earlier planting will benefit rice crops because it allows rice to rest in terms of avoiding high temperature during the most sensitive reproductive stages, but this will have implications on subsequent yields and will entail the development of suitable varieties of rice and non-rice crops to suit the new climate patterns.

2.2 Urbanization and its Impact on Climate Change

Urbanization has led to the degradation of the environmental quality, most notably the quality of the water we drink and the air we breathe. Aside from the apparent pollutants such as vehicular emissions and industrial development, one of the major contributing factors is non-environmental friendly fuel sources. The increase in the total population has generated a very high and fast growth of greenhouse gas emissions. The environmental effects of urban expansion are not limited to urban areas alone. In rapidly urban areas, pressure is being placed on the natural resources that are present. Urbanization affects the global climate because it is predicted to contribute 5% of the total emissions from deforestation and land-use change.

Bargaoui and Nouri (2017) executed a data analysis of the CO2 emissions driving forces in the context of various countries from the period 1890-2010. The results gathered by the regression analysis revealed that the relationship between both variables has positive but statistically insignificant impacts of urbanization on CO2 emissions. At the same time, population, gross domestic product (GDP) per capita, and industrialization were the critical determinants of CO2 emissions in these countries.

However, Zhang et al. (2017) came up with a different result despite using the same method, discovering a non-linear relationship between urbanization and CO2 emissions in the data gathered with 141 other countries as observations.

Another study supporting this paper was conducted by Dash and Mallick (2017). It observed data from 1990-2012 in the Middle East using the least-squares method to estimate a model in which average temperature was regressed, linking it to urbanization. The study claimed that there is a positive linkage between both variables.

Furthermore, in another study done by Chapman et al. (2017), the impacts of urbanization and climate change he urban temperatures were reviewed via a systematic review of scientific articles from 2000 to 2016. The authors have advocated that the magnitude of the impact of urbanization on temperature rise varied across nations. Another effect that urbanization has on climate change is that the migration from rural areas to urban areas results in overcrowding. Most often, overcrowding leads to pollution and poor sanitation. When the government correctly handles overcrowding, massive urban sprawling will lead to deforestation to

accommodate the migrant population. As the total population increases, the consumption of food and energy increases; consequently, this puts more strain on the usage of the natural resources that, when mishandled, will lead to total supply being diminished. In ASEAN, much of its rainforests are destroyed to create more land to house the growing population in urban cities. The rainforest, being one the most biologically diverse ecosystems – when swallowed, can accelerate climate changes. With rampant deforestation, we reduce the number of trees. With fewer trees, we have decreased oxygen supply, decreased rain, and increased carbon dioxide in the air (Shamasundari, R. 2016). Sooner or later, this will lead to the air being more humid and ultimately contributing to global warming. According to the ASEAN Biodiversity Outlook report (by ASEAN Centre for Biodiversity, Philippines), the biological diversity in the Philippines, Indonesia, and Malaysia will be greatly eroded by 2100 if the destruction of the environment persists – where "the region is poised to lose 70–90% of habitats and 13–42% of species in another 83 years".

2.3 Contribution of the Rice Industry to a country's GDP

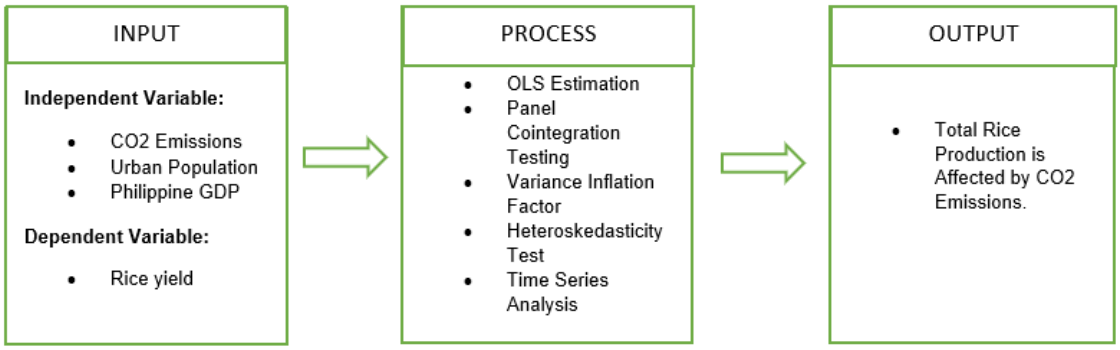
Rice is one of Asia's most valuable crops, produced by nearly two billion people and eaten by more than four billion (FAO, 2016). Asian countries produce 89 percent of the world's rice, with China and India alone accounting for 55 percent (FAO, 2016). Rice is the primary staple food and a major source of income in the Philippines. In Asia, China is the largest rice producer accounting for 31% of the continent's production in 2014. India is on track to surpass China as the world's most populous nation as early as 2022; it is the region's second-largest rice producer, accounting for 24% of total production during the 2014 harvest. Thailand, Myanmar, and the Philippines are the smallest rice producers, accounting for slightly more than 13% of the overall output on the continent (Milovanovic and Smutka, 2017). The majority of Filipinos are net buyers of rice. Although this is true for most rice-consuming countries, it is especially essential for the Philippines. In contrast to other countries, production in the Philippines has not improved as much as expected or needed. Approximately 84 percent of the overall population and 100 percent of the population's bottom two deciles are net buyers of rice. (FAO, 2018). In the study of Milovanovic and Smutka (2017), the result of their simple linear regression states that a big part of the Philippines ' GDP is correlated to rice or the rice market. Country GDP forecasts for Thailand and the Philippines are comparable to those for larger countries like China and India. On the other hand, Myanmar follows the same trend of rapid growth in rice production accompanied by higher GDP as other comparatively more minor rice-producing nations such as Vietnam and Bangladesh. Thailand has a statistically significant country export indicator, while the other two countries fail to export low-quality rice (WB, 2008). Rice is the backbone for the agricultural sector for most South Asian countries, most notably Bangladesh, India, and Nepal. Rice production and trade make up approximately 6.2% of the GDP of the three countries. India is part of the major exporters of rice in the world,

2.4. Theoretical Framework

2.4.1 Pollution Haven Hypothesis

The pollution haven hypothesis assumes that industrialized nations or companies plan to set up factories where they would have less cost. In other words, these companies would seek out countries with abundant natural resources, cheap labor, and all other factors that need to be considered. However, this usually comes with unsafe practices and degrades the environment. Nations with affordable labor and access to an abundance of natural resources are generally developing countries, and developing countries are lax regarding the environmental rules put in place. Consequently, nations that have stricter regulations tend to be more costly for these companies as there are multiple standards they have to follow. This hypothesis investigates the impact of these companies on the environment in the Philippines.

2.5 Conceptual Framework



The framework above shows the analysis between the dependent variable rice yield and the independent variables that affect rice production in the Philippine country and how the rice industry contributes to the country's total GDP. This study aims to provide an insight into how the production of rice will get by the variables that belong under the umbrella of CO2 emissions.

3. Methodology

3.1 Research Design

The researchers will use a quantitative approach to address the research problems the research faced and look at the quantitative data presented by various sources further to understand the output and relationship between the variables. More specifically, the researchers will also use time series analysis to obtain the research study's needed information to understand further how much Co2 emissions have been increasing over time and how it has affected rice production in the Philippines.

3.2 Model Specification

The thirty observations of data in this study will be gathered from credible databases such as the Philippine Department of Agriculture, Philippine Statistics Authority, World Bank, and Statista.

$$PHRP = \beta 0 + \beta 1 * PHUP + \beta 2 PGDP + \beta 3 PHCo2 + \mu$$

Equation 1. Regression model

Where the dependent variable will be represented by:
PHRP= (Philippine Rice Production)
m= slope of the regression
The independent variables will be denoted in the following:
PHUP= first independent variable (Philippine Urban Population)
PGPD= second dependent variable (Philippine Gross Domestic Product)
PHCo2= third independent variable (Philippine Carbon Dioxide Emissions)
μ= constant

3.3 Statistical Tool

EViews will be the main statistical program that the researchers will use to analyze the data observations critically. In this context, this paper will conduct numerous econometric tests on the relationship between CO2 emissions and rice yield in the Philippines using annual time series data from 1988-2017.

3.3 Statistical Treatment

The researchers will be using statistical tools such as EViews and Microsoft Excel to identify and study the relationship between the dependent and independent variables. As previously mentioned, the data gathered will undergo a series of tests; Specifically, variance inflation factor, heteroskedasticity test, Johansen panel cointegration test, and Ordinary Least Squares (OLS) estimation.

3.3.1 Variance Inflation Factor

The variance inflation factor measures multicollinearity in a set of multiple regression variables. The researchers use the variance inflation factor in the study, testing whether the dependent and independent variables correlate.

3.3.2 Heteroskedasticity test

The Heteroskedasticity test in a linear regression model tells us whether the variance of the regression errors depends on the independent variable. The researchers use the heteroskedasticity test to see if the residuals are evenly distributed.

3.3.3 Johansen Panel Cointegration Test

The Johansen Panel Cointegration Test is used to test cointegrating relationships between the data in the study.

3.3.4 Ordinary Least Squares (OLS) estimation.

The Ordinary Least Squares estimation is an analysis that estimates the relationship between the dependent and independent variables by minimizing the sum of the squares in the difference between the predicted and observed values. The researchers use OLS estimation to test the 30 observations if they have a goodness of fit of at least 95% confidence.

3.5 Preliminary Data Testing

From the obtained data gathered from different credible sources as mentioned in Chapter 3, the regression model of this study is stated as follows:

$$PHRP = \beta 0 + \beta 1 * PHUP + \beta 2 PGDP + \beta 3 PHCo2 + \mu$$

Equation 1. Regression model

Where the dependent variable will be represented by:
PHRP= (Philippine Rice Production)
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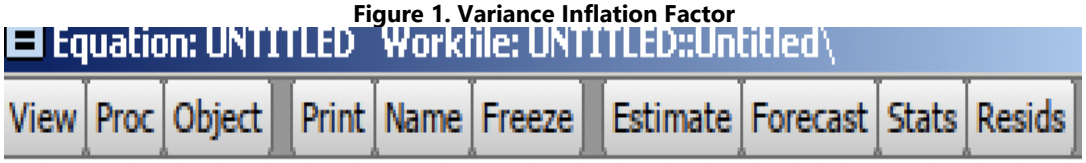
The independent variables will be denoted in the following:
PHUP= first independent variable (Philippine Urban Population)
PGPD= second dependent variable (Philippine Gross Domestic Product)
PHCo2= third independent variable (Philippine Carbon Dioxide Emissions)
μ= constant

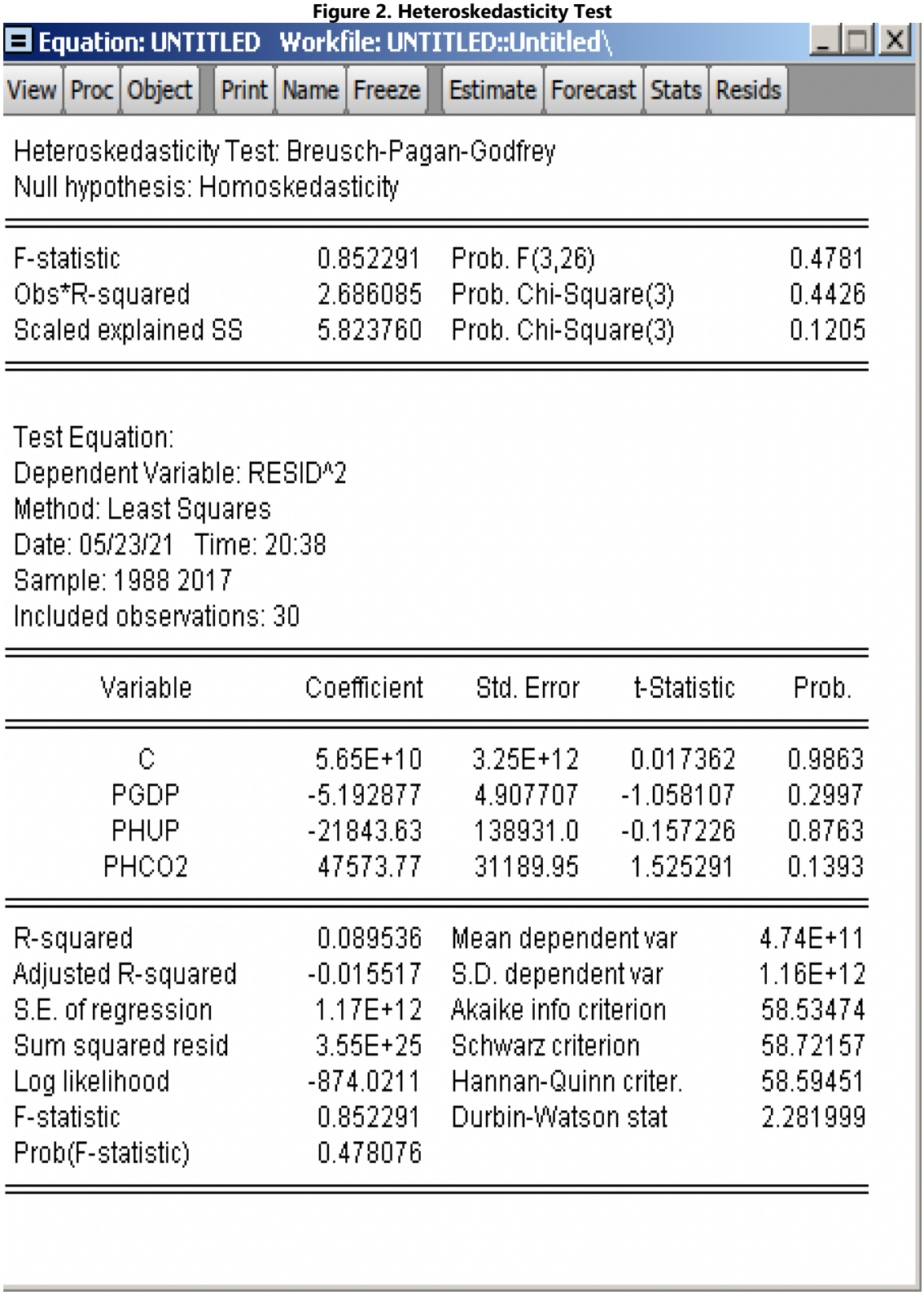
Figure 1. Variance Inflation Factor



Variance Inflation Factors
Date: 05/23/21 Time: 20:46
Sample: 1988 2017
Included observations: 30

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	4.25E+12	232.7139	NA
PGDP	9.66E-12	115.4162	18.94103
PHUP	0.007740	620.4286	16.44749
PHCO2	0.000390	124.2964	11.26752

Figure 2. Heteroskedasticity Test



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Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.852291	Prob. F(3,26)	0.4781
Obs*R-squared	2.686085	Prob. Chi-Square(3)	0.4426
Scaled explained SS	5.823760	Prob. Chi-Square(3)	0.1205

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/23/21 Time: 20:38
Sample: 1988 2017
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.65E+10	3.25E+12	0.017362	0.9863
PGDP	-5.192877	4.907707	-1.058107	0.2997
PHUP	-21843.63	138931.0	-0.157226	0.8763
PHCO2	47573.77	31189.95	1.525291	0.1393

R-squared	0.089536	Mean dependent var	4.74E+11
Adjusted R-squared	-0.015517	S.D. dependent var	1.16E+12
S.E. of regression	1.17E+12	Akaike info criterion	58.53474
Sum squared resid	3.55E+25	Schwarz criterion	58.72157
Log likelihood	-874.0211	Hannan-Quinn criter.	58.59451
F-statistic	0.852291	Durbin-Watson stat	2.281999
Prob(F-statistic)	0.478076		

Figure 3. Johansen Panel Cointegration

Group: UNTITLED Workfile: UNTITLED::Untitled\

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Johansen Cointegration Test Summary

Date: 05/21/21 Time: 23:11
Sample: 1988 2017
Included observations: 28
Series: GDP PHUP PHRP PHCO2
Lags interval: 1 to 1

Selected (0.05 level*) Number of Cointegrating Relations by Model

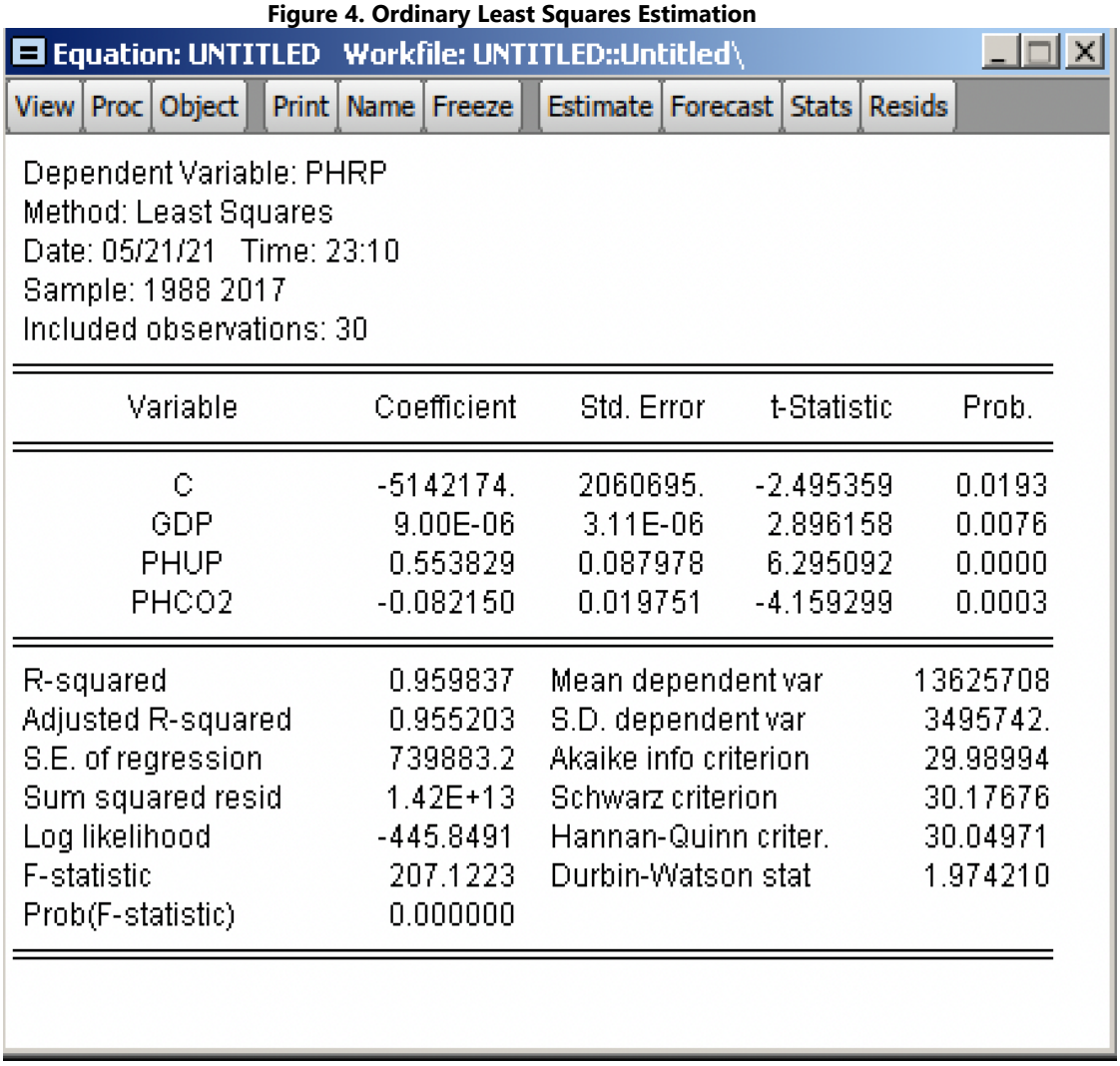
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	3	4	3	4	3
Max-Eig	3	4	3	4	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	-1921.643	-1921.643	-1915.950	-1915.950	-1904.739
1	-1907.289	-1907.269	-1901.587	-1899.436	-1890.501
2	-1894.854	-1894.530	-1888.977	-1886.489	-1878.360
3	-1888.911	-1884.020	-1879.136	-1874.574	-1868.024
4	-1888.692	-1878.937	-1878.937	-1867.718	-1867.718
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	138.4030	138.4030	138.2822	138.2822	137.7671
1	137.9492	138.0192	137.8276	137.7455	137.3215
2	137.6324	137.7521	137.4984	137.4635	137.0257
3	137.7794	137.6443	137.3668	137.2553	136.8588*
4	138.3351	137.9241	137.9241	137.4084	137.4084
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	139.1643	139.1643	139.2337	139.2337	138.9090
1	139.0911	139.2087	139.1598	139.1252	138.8440*
2	139.1550	139.3698	139.2112	139.2715	138.9289
3	139.6825	139.6901	139.4603	139.4915	139.1426
4	140.6189	140.3982	140.3982	140.0728	140.0728

Figure 4. Ordinary Least Squares Estimation



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Dependent Variable: PHRP
Method: Least Squares
Date: 05/21/21 Time: 23:10
Sample: 1988 2017
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5142174.	2060695.	-2.495359	0.0193
GDP	9.00E-06	3.11E-06	2.896158	0.0076
PHUP	0.553829	0.087978	6.295092	0.0000
PHCO2	-0.082150	0.019751	-4.159299	0.0003

R-squared	0.959837	Mean dependent var	13625708
Adjusted R-squared	0.955203	S.D. dependent var	3495742.
S.E. of regression	739883.2	Akaike info criterion	29.98994
Sum squared resid	1.42E+13	Schwarz criterion	30.17676
Log likelihood	-445.8491	Hannan-Quinn criter.	30.04971
F-statistic	207.1223	Durbin-Watson stat	1.974210
Prob(F-statistic)	0.000000		

4. Findings and Data Analysis

The results that are regressed will be summarized in this chapter. Quantitative data gathered from reliable databases such as the Philippine Department of Agriculture, Philippine Statistics Authority, World Bank, and Statista is tested using the Eviews tool.

With thirty observations, the regression results state that 95% of Philippine Rice Production movement is due to the three dependent variables. The intercept is -5142174. The result shows that the P-value is 0.0193, the value is lower than 0.05, giving the idea that the coefficient is also strongly significant at the 5% level. There is a positive coefficient on Philippine Gross Domestic Product and Philippine Urban Population; positive coefficient means that the relationship between the two dependent variables have a positive effect on the dependent variable, while there is a negative coefficient on Philippine Carbon Dioxide Emissions giving the impression that the relationship of the independent variable has a negative impact on the dependent variable. Individually, when the value of PGDP increases or decreases by one, then the value of PHRP will increase or decrease by 0.000009; when the value of PHUP increases or decreases by 1, the value of PHRP will increase or decrease by 0.55; when the value of PHCO2 increases or decreases by 1, the value of PHRP will decrease or decrease by 0.08 respectively—with a probability of 0, giving the idea that the regression is significant. The Durbin-Watson that is included in the OLS estimation has a value of 1.974210; the interpreted value is closer to the value of 2; rule of thumb: values in the range of 1.5 to 2.5 are relatively normal. Thus, the regression shows that there is a normal autocorrelation.

Variance inflation factor (VIF) shows that there is the existence of multicollinearity in the regression model; the three dependent variables have a centered VIF above the value of 10, indicating that there is severe multicollinearity between the variables.

The researchers used the Breusch-Pagan-Godfrey method to test for heteroskedasticity. The result states that the data is homoskedastic, indicating that points plotted are similar in distance from the regression line.

5. Conclusion and Recommendations

This study is necessary in order to understand how climate change affects rice production in the Philippines and to explain the existing situation. The researchers want to present and explain the data they've collected to local farming groups and communities so they can better grasp what's going on and adjust to the risks and opportunities that climate change may bring.

The results of the study conducted by the researchers concluded that climate change affected the total rice yield of the Philippines from years 1987-to 2016. The relationship between the dependent and independent variables was indirect; as people moved into urban areas, this caused pollution less population working on agricultural farming, thus leading to the production level of rice diminishing slowly. However, the results were not consistent in all years, while the relationship results suggested a trend. The findings of this study indicate that the Pollution Haven hypothesis is evident in the Philippines; carbon emissions and urban population have been increasing over the years, while the Philippines' total rice production is affected by the increase of carbon emissions.

Developing countries account for over 75% of total direct greenhouse gas emissions, and this number is likely to climb in the future years. On the other hand, developing countries are not sleeping on the issue, as they have begun to address it. African countries have concentrated their efforts on the agriculture sector in order to cut carbon emissions. Given the crucial role rice plays in feeding the world's rising population, it is critical to increase rice production. The expansion of rice cultivation in Ghana, where rice is a staple, has been prompted by a production shortage. On the other hand, intensification of production is inextricably linked to an increase in GHG emissions. The rapid growth of the global population has resulted in a very large and rapid increase in greenhouse gas emissions. The environmental consequences of urbanization are not limited to cities. The natural resources that exist in rapidly urbanizing places are being put under strain.

The research was limited to the Philippines as a whole; concentrating on a single region in the Philippines may vary in results. Data gathered by the researchers were from secondary sources; the researchers were not able to gather data from primary sources due to multiple barriers, such as; the Covid-19 pandemic and geographical constraints. For future researchers who will tackle similar topics, the researchers would like to recommend focusing on a specific region; the researchers suggest that future researchers tackle a region that focuses on the specific crop being studied.

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Conflict of Interest: The authors declare no conflict of interest

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