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A Study on the Economic Sustainability of Local Coffee Production in the Philippines

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Abstract

The coffee has been a major source of income for centuries now, it sure does contribute to the country's productivity, specifically agricultural sectors. This study seeks to identify whether the local coffee production can keep up with the rising demand for coffee in the Philippines. The country's local coffee production is examined to know whether it will be a sustainable source for the country's coffee industry in the long-run and whether its production would be a good investment for several companies. This study determines the impact of local coffee consumption to the shortage of local coffee beans and surplus in the demand for coffee in the country. Furthermore, by using a time series regression analysis, the study determines whether the local coffee production has positive or negative effects on each variable. Using the gathered data from different academic references, this study identified the relationship of the local coffee production among each variable.

Keywords: economic sustainability, local coffee production, coffee consumption, coffee industry

Introduction

Consuming coffee has always been a normal thing to do in the Philippines. History states that coffee was introduced in the Philippines more than two centuries ago. It also serves as a source of income for a lot of farmers and even businesses locally (Tan, 2020). Coffee is even the second most traded commodity across the world, next to Petroleum (Chengappa & Devika, 2016). Furthermore, Filipinos have experienced or developed a place attachment to their respective favorite coffee shops over time. Majority of the respondents stated that drinking and dining is their primary reason for going to coffee shops, which equates to 46% of the respondents. While other reasons include relaxing and either work or study, 81% of the respondents treat coffee shops as a public gathering place (Tumanan and Lansangan, 2012).

The International Coffee Organization (ICO, 2021) has gathered nearly 60 countries that produce coffee, of which the Philippines is part of the coffee-producing countries. This production plays a significant role in the economy and employing people (Reinecke et al. 2012). Italy has a significant role in the international coffee industries, in terms of exportation. They even buy green coffee beans from exporting countries then sell them to importing countries after processing

(Pascucci, 2018) and exports served as a significant factor in achieving economic growth (Murindahabi et al., 2019).

However, there are several factors that might affect the quality of coffee production. Several journals tackled how the irrigation system works in the agricultural sector. A drip irrigation system is a type of irrigation technique that is the most efficient irrigation method (Megersa & Abdulahi, 2015). On the contrary, both drip and sprinkler irrigation techniques are suitable to use in the agricultural sector. Based on the results of the study, drip and sprinkler irrigation are both applicable because they provide lower amounts of water to maintain the improvement of productivity (Albaji et al., 2016). Given the significance of irrigation in agriculture, irrigated crops produced a much higher long-run mean yield than the non-irrigated ones. The irrigation method has a vital part in the agricultural sector by building up crop yields by ensuring that water is available (Lu et al., 2020). Investing in irrigation in the Philippines is one of the strategies to enhance productivity in the agricultural sector. An irrigation development made a massive amount of contribution to the development of agriculture in the Philippines (Perez et al., 2018). Morevoer, consumers' preferences are substantial, especially for various coffee attributes. Previous studies discussed two factors; personal preferences and economic characteristics applied that hinder coffee consumption (Samoggia & Riedel, 2018). The estimated average coffee consumption per day from the entire population was 163 ml which depicts 1.5 cups intake daily among Brazilians (Sousa & Da Costa, 2015).

The present study aims to examine if agricultural irrigation is sustainable for local coffee production, in the long run, to determine if the local coffee production can afford to keep pace with the demand from domestic consumers, to identify if the size of harvest areas affect coffee yield, to determine if the relationship between variables exist, examine the coffee production if the Philippines can export the quality and quantity of coffee the consumers from other countries demand, and to scrutinize if applying fertilizer to coffee plantations affect the local production positively or negatively.

2. Literature Review

2.1. Local Coffee Production and Consumption

In 30 years, International Coffee Organization (ICO, 2020) presented the data of the Philippine total coffee production in which by 1990, the country produced 974,000 of 60 kg bags which instantly decreased from 1992-1996. However, it recovered for only a year to increase its production but through the years, coffee production in the Philippines has been inconsistent since then. With four different coffee variants, the Philippine Statistics Authority (PSA, 2018), stated that in 2013, the production of coffee declined from 78.63 thousand metric tons to 62.08 in 2017.

In comparison, the coffee consumption in Indonesia continuously grows due to the marketing strategies and brand awareness efforts. Furthermore, the consumption from the said country is empowered by the coffee shops that are expanding that even includes franchises and small businesses (Wang, 2017). The relevance of the aforementioned is that the said strategies or

efforts can be adapted in the Philippines since the consumption of coffee is high. Data from the International Coffee Organization (ICO, 2021), presented the domestic consumption for coffee (in thousand 60kg bags) of the Philippines has steadily increased from 1990 to present. The highest amount of domestic coffee consumption reached 3.3 million of 60kg bags from 2018 to 2019 compared in 1990 to 1991, which is just around 720,000 60kg bags.

Coffee consumption in Indonesia is still rising in which the country becomes the 8th largest consumer in the world. Wang (2017) used a Grey system modelling to forecast the real data gathered in which the results are seen to be accurate and that the consumption of coffee in Indonesia will still increase in each year. Producing countries do not preserve most of the profit brought about by the coffee production. The behavior of the demand of the consumers is inevitable to change and the market will most likely stay adapting itself in order to suffice the changes. It is also stated in the study that richer nations are usually related to higher coffee consumption as a portion of total world production (De Lima, et al., 2020).

2.2. Coffee Exports

Total exports of coffee beans are declining rapidly, along with the total production of coffee beans, despite the latter being able to stabilize around 2010 (ICO, 2021). Enhanced policies helped to improve the development and quality of the coffee industry, both the local consumption and market exportations. Given that Indonesia is one of the major producers in the coffee industry, it mostly exports for the global market. So as to improve the competitiveness and sustainability of the coffee industry, policies are suggested to be able to increase the level of productivity and empower the smallholder farmers performances (Arifin, 2013). The Philippines coffee exports in 2014 was US$3.2 million. In addition, it contributes less than 0.009% of the global trade supply. Instant coffees are the largest export in the Philippines with the value export of 82% in the year of 2014, however, the extract plunged from US$6.2 million in 2005 to US$2.6 million in 2014. With the same period, the Philippines' total exports of raw, semi-processed and processed coffee also dropped by US$4 million, from US$7.2 million to US$3.2 million (Bamber et al., 2017). Fair trade is welfare improvement, a policy to address market failures present in coffee production, as seen in the short run, partial equilibrium model that takes market failures into account (Tedeschi & Carlson, 2011).

2.3. Coffee Yield and Harvest Area

Selected Statistics on Agriculture shows that the mean of metric tons for coffee production is 112,000.30 metric tons, and the average harvest area is equivalent to 130,000.89 hectares. Upon dividing the mean of harvest area from the mean of metric tons, the coffee yield amounted to 0.86 metric tons per hectare (Philippine Statistic Authority, 2021). Also, the impact of climatic variables are the most important factors to control the yield and quality of Arabica coffee beans (De Oliveira et al., 2017). From 1984, the harvested coffee area in Brazil was 2.51 million hectares, which decreased in 2016 to just 1.99 million hectares, which indicates a 20.3% decline

in the area. The gains in Brazilian coffee production arises because of technological improvements and adoption of new varieties and techniques (Volsi et al., 2019). The pre-harvest and post-harvest activities starting from selecting the best quality coffee, processing, drying, hulling, storage, roasting, grinding, and brewing can influence the coffee quality. The chemical compositions and physical properties of coffee beans are affected by different factors such as environment, genetics, agronomic activities, harvesting, and post-harvest operations (Haile & Hee Kang, 2020). With the eight programs tested, two programs are said to be urgently required, namely rehabilitation of plants and stabilization of coffee prices; both deemed to be significant programs to increase the production of coffee since Indonesia's productivity declined, which the harvest area for coffee plants effectively dropped, and the said programs are important for the next production (Nuddin, et al., 2019).

2.4. Agricultural Irrigation

A study presumed that there is a possibility to abate the volume of the irrigation method without having an impact on the coffee yield. There is a possibility to abate irrigation of consumptive water use and the elevation in yields in the production of coffee in Vietnam. Hence, it still necessitates induced water stress through a shortage of irrigation water depending on the scheduling of the practices such as irrigation managing other inputs and agronomic practices. Also stated is the potential to provide water for the plantations. Whereas, during the dry seasons which fall from February to March in Vietnam, agricultural crops require irrigation to reduce the water stress from the dry season. Overall, irrigation has a significant impact on the sustainability of coffee production (Amarasinghe et al., 2015).

The Smart Irrigation Decision Support System was proposed to regulate agricultural irrigation since it is mentioned that managing the irrigation system is a priority to sustain beneficial crops. The system evaluates the weekly irrigations needed for a plantation, according to both measurements of soil and climatic variables. The previous researchers proposed the system to discuss whether the usage of machine learning techniques with weather and soil as variables are significant or it could offer an automated closed loop system to be able to forecast the needs of irrigation every crop (Navarro et al., 2016).

With the use of the irrigation method as the major factor that affects both agricultural productivity and environmental resources, evaluating global interactions of both the production in agriculture and the access of land and water resources. The previous researchers combined alternative irrigation systems to a new model to evaluate the adaptations of water usage in agriculture for various development occurrences. Overall, the previous researcher adopted a more advanced approach in the irrigation system. It also ought to assess the role of irrigation and water resources for the future of food security and generic socio-economic welfare (Sauer et al., 2010).

One requirement of sustainable crop production is water from irrigation systems which must suffice the needs of the crops to achieve the possible bear. Also stated in the study, to obtain an increase of efficient usage of water in agriculture, it must not impair unnecessary waste of water

resources and avoid exceeding water requirement for every crop production (Saccon, 2018). On the contrary, the dynamics of irrigation sustainability in the agricultural sector, and the analyzation of the study, the previous researchers concluded that the use of technology have impacted the development of irrigation systems and the loss of water scarcity which contributes to the improvement of water usage efficiency and sustainability of the areas in drought regions (Velasco-Muñoz et al., 2019).

The agricultural complexity, specifically the involvement of different decisions of farmers with different interests on how to manage the production is over throwed. The previous study also proposed a software-based system which is called Decision Support System that provides decision-makers in agriculture to obtain information to apply water management since irrigation is a useful approach to accurately supply water for the crop productions (Rinaldi and He, 2014). A sustainable strategy contradicted the previous statement, to abate the consumption of water in the production of crops whereas the consumption will not take into account the yield production although the supply of water is limited (Du et al., 2015).

Irrigation resulted in high productivity in agriculture with efficiency. It was raised to revitalize the irrigation system to improve the production in agriculture. Considering the climatic conditions in every region, the irrigation systems have a significant relationship with agricultural productivity (Mihailović et al., 2014). Contrarily, an ARM 9 processor which controls and observes the system of irrigation, provides saturation to the soil for a long time after the process is done. Using the processor, drip irrigation is for efficiency to save manpower and water which enhances the production of crops to increase the profit (Kavianand et al., 2016).

An experimental method which determines that rational irrigation and shading modes for efficient light and water use are suitable for the production and quality of coffee beans. Different levels of irrigation; full and deficit, were applied in the experiment conducted in the study which concludes that a mild deficit irrigation compared to a full irrigation improves efficiency and quality of a coffee bean. Correspondingly, mild deficit irrigation will help improve the production and the efficient use of water without overthrowing the produced coffee bean (Liu, et al., 2018). Another study recommended that increasing the investment for a rapid irrigation development would contribute to the development of agriculture in the Philippines, the researchers addressed that using water efficiently through irrigation improves crop productivity (Perez et al., 2018).

In contrast, a proposed agricultural irrigation system based on internet technology by means of controlling the water-saving irrigation system maximizes the use of water and enhances the utilization of water which embellished the productivity of water (Li, 2012). Innovation solves the complexity of climatic conditions which equates to dryness of crop production. Innovation is not just to improve competitiveness of the agri-food sector but to increase the level of productivity (Oliveira et al., 2019). However, innovating the irrigation system costs largely on capital investment and is uneasy to apply. But to solve the problems in agriculture, specifically the management of innovative irrigation, the researchers designed a closed pipe water distribution network which improves crop yield and saves an amount of water (Bhalage et al., 2015). The result

depicts that irrigation has a huge impact in the agricultural sector and that irrigating sufficiently in agriculture is vital in tropical Asian countries (Lee, et al., 2012).

Resiliency in agriculture to climate change heaves the improvement of production of agriculture by providing a sustainable development. The use of irrigation and rainfall as variables resulted with different effects to estimate the different impacts on agricultural production. Irrigation per se, has a positive and significant effect on aggregate agricultural production. Climate-smart agriculture enhances the productivity of agriculture for long-term sustainability agriculture and food production. Thus, it suggests policies and practices in order to improve the irrigation and water management in agriculture (Olayide et al., 2016). Lastly, with different irrigation techniques, few smallholder coffee farmers in Vietnam refused to apply the two irrigation techniques; drip and sprinkler irrigation. Mainly because of the large investment that it will cost. Therefore, smallholder coffee farmers who may not be able to obtain access in the irrigation system will most likely use the traditional farming methods for less cost and due to lack of resources. Although there are no differences in using the sustainable system to the production of coffee than the conventional, it is proven that sustainable irrigation is more profitable and cost-effective than the latter (Hung Anh et al., 2019).

2.5. Fertilizer

The impact of fertilizers on coffee production cost resulted in the proposal that the evaluation of the transverse distribution of fertilizer on coffee crops was practical and efficient (Andrade, et al., 2020). Nitrogen (N) dynamics in plants during their development in agricultural crops. In a labeled fertilizer field study 15N accumulation in different plant parts of mature coffee was observed over time. This experiment assessed the N absorption changes in plant compartments over time for a coffee crop grown in the Brazilian “cerrado” that was previously cultivated under high N fertilizer rates (Bruno et al., 2011). Another study evaluated the impact of the fertilizer credit on input use for crop production, crop choice, crop yield, and household income. In result, the credit access increases inorganic fertilizer use by 35 kg per household. In addition, credit access increases the yield of teff by 37% but not the other major crops, such as maize and wheat. The results raise a concern about the effectiveness of the credit program in Ethiopia in improving the living conditions of the farmers (Matsumoto & Yamano, 2011). Coffee husk, which is a rich organic agricultural waste and potassium, was a good material for the composting process to reduce the time of composting and improve the quality. In addition, partial substitution of chemical fertilizer with the compost contributed to improve the fertility of the coffee soil, nutrient uptake in the leaves, and the rate of branch growth (Dzung, et al., 2013).

Fertilizer is an indispensable input in modern agriculture. The widespread use of fertilizers has greatly contributed to the huge increases in food and feed production worldwide during the last six decades, together with improvements in crop and animal traits, irrigation and drainage, and pest and disease management. It was predicted that fertilizer use and nutrient losses to the environment continuously increased in the coming decades (Li et al., 2012). The fertilizer sector has grown dramatically since the 1950s, owing to adopting modern technology in Philippine

agriculture. Through this, application of fertilizers realized the high yield potential from modern technologies and varieties, which exhibited better fertilizer response compared to traditional varieties (Briones, 2014).

3. Method

This study used a quantitative research design. Specifically, a time series regression method. A quantitative research design can be classified into four types; the descriptive, correlational, causal-comparative, and experimental which all identify the manipulation of variables whether the independent variable has an impact on the chosen dependent variable (Regoniel, 2020). It entails the measurement and presumes the occurrence under a study to be measured. It delineates the aim of analysing data for relationships and trends to validate the measurements made (Watson, 2015). Using the quantitative research design, the present researchers were able to determine the relationship between the chosen dependent variable which is the local coffee production and the chosen independent variables.

This study identified whether local coffee production is affected positively or negatively by all variables mentioned in the previous chapters by using a time series regression model to examine the contribution of the former. The present researchers used the gathered data in determining the local coffee bean production is sustainable to put up on the country's GDP. Using different applicable tests, the present researchers determined whether the sustainable coffee production has a positive or negative relationship with the independent variables by using the data gathered from different sources which determined if these variables depict the impact on the country's GDP. By using time series regression method, the present researchers were able to comprehend the prevailing observations using the gathered data through the specific time period. Through the gathered data, the present researchers used a time series data regression model to identify the differences of coffee production in the Philippines. Through the years, there was an improvement to the production and quality of coffee.

This study has gathered the secondary data needed for the study from various reliable sources that were available on the Internet for free. Data gathered includes total amount of coffee beans produced locally, domestic consumption, total exports, coffee yield, total harvest area for coffee, total amount of agricultural irrigation (in mm -- millimeter), correspondingly, the amount of fertilizers. The sources used to conduct the study were from the World Bank database, Philippine Statistics Authority, and International Coffee Organization.

This study also determined the possible consequences of the decline in the local coffee production in the Philippines by analyzing the variables; domestic consumption, total coffee exports, coffee yield, harvest area, agricultural irrigation, and agricultural fertilizers. Wherein the domestic consumption and total exports were measured by in thousand 60kg bags and crop years (e.g 1990,91), coffee yield was measured by dividing the metric tons (in thousands) by the harvest area (in thousands), harvest area (measured in thousand hectares), agricultural irrigation [measured

through 1 millimeter (mm) = 1 square meter (sqm) = 1 liter], and agricultural fertilizers (in thousand metric tons).

Using these variables, referring to the gathered data, local coffee production has a sustainable impact on the economy in the long run. In the next section, these economic tests will determine the relationship between the dependent variable and independent variables of the study.

$$local\ coffee\ production = \beta_0 + \beta_1 Consumption + \beta_2 Exports + \beta_3 Yield + \beta_4 Harvest\ Area + \beta_5 Irrigation + \beta_6 Fertilizer + e$$

Test for Heteroskedastic Disturbances

If the variance of the regression residuals of the model is time varying, the parameters and their standard errors are said to be biased and inefficient. This condition is known as heteroskedasticity and if uncorrected could lead to wrong conclusions and decisions on the part of the investigator. To detect the presence of heteroskedastic disturbances in the residuals, the White Heteroskedasticity Test will be used.

$$u^2 = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_1^2 + \alpha_5 X_2^2 + X_3^2 + \alpha_6 X_1 X_2 + \alpha_7 X_1 X_3 + \alpha_8 X_2 X_3 + v_t$$

where u^2 is the squared regression residuals regressed against the explanatory variables, their squares, and cross products.

Johansen Cointegration Test

In applying the Johansen Cointegration Test which consists of five options, although options 1 and 5 are avoided because of their explosive values which are not consistent with economic realities, such options were utilized according to the Dickey-Pantula principle by beginning with the most restrictive (Option 2) down to the least restrictive (Option 4).

If the computed *trace statistics* and *maximum-eigenvalue statistics* exceed their critical values, then there is cointegration among the variables. The hypothesized relationships cannot be deemed spurious and therefore genuine equilibrium relationships existed.

4. Results and Discussion

Table 1 shows that domestic consumption, coffee yield and harvest area have positive significant relationships on local coffee production while total exports are insignificant. The behavior of consumer demand increases which the market certainly adapts prior to suffice the flow of coffee production and consumption in the country which depicts the significance of both domestic consumption and local coffee production (De Lima, et al., 2020). One contradicted the result of the present study because the harvest coffee area in Brazil declined, however, it constantly

evolved its production through the help of technological techniques adapted by the coffee farmers which differed in this case since Table 1 depicted that harvest area and local coffee production are significant (Volsi, et al. 2019). However, the increasing water supply, integrated water management, and increase in investment are the strategies that serve in production when it comes to farming (Perez, et al., 2018).

Table 1. Regression results
Dependent Variable: LOCAL_COFFEE_PRODUCTION
Sample (adjusted): 1990 2019

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-117.3732	6.147535	-19.09272	0.0000
DOMESTIC_CONSUMPTION	0.002349	0.000648	3.624973	0.0013
COFFEE_YIELD	132.1394	4.284364	30.84225	0.0000
HARVEST_AREA	0.867826	0.030325	28.61756	0.0000
TOTAL_EXPORTS	0.011656	0.007612	1.531175	0.1383
R-squared	0.998444	Mean dependent var		103.5033
Adjusted R-squared	0.998195	S.D. dependent var		24.80411
S.E. of regression	1.053840	Akaike info criterion		3.093769
Sum squared resid	27.76445	Schwarz criterion		3.327302
Log likelihood	-41.40654	Hannan-Quinn criter.		3.168479
F-statistic	4010.143	Durbin-Watson stat		1.442898
Prob(F-statistic)	0.000000			

Table 2 shows that there are at most five cointegrating variables using Trace Statistic and Max-Eigen statistic. The result of the probabilities that has the value less than the 0.05 it means that the result would be considered as accepted. Conversely, the result that has surpassed the value of 0.05 will be rejected. Furthermore, on the Traces statistic column that shows on the table 2 the at most 1, At most 2, At most 3, At most 4 and 5 contains the result that is lower than the value of 0.05 it means that it is accepted. On the other hand, the at the most 6 has surpassed the value of 0.05 that means it is rejected. The Max-Eigen Statistic has a different result from the Trace Statistic besides that at most 1-6 all surpassed the 0.05 value it means that these probabilities are accepted.

Table 2. Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Trace Statistic	Prob.*	Max-Eigen Statistic	Prob.*
None	205.6499	0.0000*	79.79903	0.0000*
At most 1	125.8509	0.0001*	39.98133	0.0513*
At most 2	85.86954	0.0016*	29.82507	0.1413
At most 3	56.04447	0.0071*	21.91030	0.2250
At most 4	34.13417	0.0149*	16.73280	0.1850
At most 5	17.40137	0.0255*	15.01089	0.0380*
At most 6	2.390484	0.1221	2.390484	0.1221

Table 3 shows that domestic consumption, coffee yield, harvest area and irrigated service area have positive significant relationships on local coffee production while total exports and total supply of fertilizers are insignificant. The transverse distribution of fertilizer on coffee crops is practical and efficient (Andrade et al., 2020). For instance, the P values which are represented by the Prob column on the table 3, depict the value is less than the 0.05 significance level, which means that the Independent Variable would be significant to the Dependent Variable which is the Local Coffee Production. In contrast, as the significance level exceeds the 0.05 value, the Independent Variables would be insignificant to the Dependent variable. Definitely, the IV1, IV2,

and IV6 all contain the value that has a higher than the significance level of 0.05 which makes them insignificant to the Dependent Variable or the Local Coffee Production. Differing from the other Independent Variables which are IV3, IV4, and IV5 all contributing the value that is less than the 0.05 significance level it means that these Independent Variables are significant to the Dependent Variable.

Table 3. Regression results
Dependent Variable: LOCAL_COFFEE_PRODUCTION
Sample (adjusted): 1990 2018

Variable	Coefficient	Std. Error	t-Statistic	Prob.	VIF
Constant	-128.6859	5.881836	-21.87852	0.0000	NA
DOMESTIC_CONSUMPTION	0.001174	0.000665	1.765941	0.0913	13.77471
TOTAL_EXPORTS	0.006537	0.006291	1.039152	0.3100	1.536341
COFFEE_YIELD	135.4953	4.103300	33.02105	0.0000	8.750167
HARVEST_AREA	0.860943	0.024836	34.66496	0.0000	4.192124
IRRIGATED_SERVICE_AREA	6.503767	1.895187	3.431728	0.0024	4.821608
TOTAL_SUPPLY_FERTILIZERS	0.000692	0.000405	1.707696	0.1018	1.547115
R-squared	0.998993	Mean dependent var		105.0034	
Adjusted R-squared	0.998719	S.D. dependent var		23.81796	
S.E. of regression	0.852504	Akaike info criterion		2.725228	
Sum squared resid	15.98880	Schwarz criterion		3.055265	
Log likelihood	-32.51581	Hannan-Quinn criter.		2.828592	
F-statistic	3639.028	Durbin-Watson stat		1.975552	
Prob(F-statistic)	0.000000				
Jarque-Bera (Residuals)	1.386126				
Prob(Jarque-Bera)	0.500042				

Table 4 shows that there is no serial correlation in the regression using the Breusch-Godfrey serial correlation test and there is no heteroskedasticity error using the Breusch-Pagan-Godfrey test and the ARCH test. In addition, the F statistics tests contrast what would be the joint effect of these variables. Also, the Breusch-Godfrey Test is included in the determination of whether heteroskedasticity is presented in the Regression model or not. Besides, there is no error found on the Heteroskedasticity test because it would be present in the Regression model. Along with the presence of the Heteroskedasticity it means that it would create a plot of the residuals opposed to the fitted values of the model.

Table 4. Diagnostic test results

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	0.063981	Prob. F(1,21)	0.8028
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoscedasticity			
F-statistic	1.865366	Prob. F(6,22)	0.1325
Heteroskedasticity Test: ARCH			
F-statistic	0.183387	Prob. F(1,26)	0.6720

Conclusion

In order to increase the sustainability of producing coffee crops in the country, the Philippines, this study would recommend applying the possible improvements stated in the results of the study. The agricultural sector contributes to the economy of a country, which depicts that by increasing the government investment in the coffee sector in the Philippines, the agricultural sector will also increase its contribution to the Philippine economy (Murindahabi et al., 2019).

Silang, Cavite is the most recommended municipality for the coffee farmers to produce crops, with that being said, coffee farmers may have different municipalities, the said coffee farmers should adapt the productivity of Cavite farmers to sustain their locally produced coffee, and as many municipalities have adapted the system, the coffee sector would increase its productivity to help contribute to the agricultural sector in the Philippines (Cubillo, 2016). Another recommendation for coffee farmers from the Philippines is that coffee waste can be an alternative fertilizer in planting coffee crops instead of using chemical fertilizers. This would not just help improve the yield of coffee produced, but also serves as a near standard to help sustain not just the environment but also the economy. Furthermore, the coffee waste gathered from various methods such as coffee brewing, can be used in producing industrial products like biochar and biogas through pyrolysis (Ktori, et al., 2018).

According to the tests conducted, the domestic consumption, coffee yield, harvest area, and irrigated service area have positive relationships with Local Coffee Production. Whilst the total exports and total supply of fertilizers have an insignificant relationship with Local Coffee Production. The four aforementioned variables that have a positive relationship with Local Coffee Production will determine the longevity of Local Coffee Production. Since one of the variables that have a positive relationship with Local Coffee Production is domestic consumption, we can conclude that Local Coffee Production will remain in the long run, or better yet, improve. If domestic consumption will continue to grow, so will the Local Coffee Production since they have a positive relationship, assuming that the variables mentioned above will also improve in the long-run.

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