

Factors Affecting the Agricultural Productivity in the Philippines

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Abstract: In many developing countries like the Philippines, agriculture is one of the primary sources of income. With the potential to boost farmers' income and rural poverty reduction, it must increase agricultural productivity. Most people in rural areas depend on agriculture for employment and income; thus, shallow productivity results in low farmer income. This study sought to know how the agricultural factors of economics affect the total productivity, particularly how agriculture land, labor, and capital affect the agricultural productivity in the Philippines. Ordinary Least Squares (OLS) regression analysis was used in this work for determining the parameters and the relationship between the variables, covering data from 2000 to 2021. The study's conclusions provided valuable insights for the Philippines' agriculture sector to formulate more effective policies and strategies that enhance agricultural productivity by improving the relationship between the variables. These benefit the government institutions and the farmers, the primary stakeholders in the agriculture sector, which can strengthen agricultural productivity in the Philippines.

Keywords: Agricultural productivity, Employment, Gross capital formation, Income, Land.

1. Introduction

Agriculture in developing economies is crucial to economic development. This sector serves as their primary source of rural employment and economies and has significantly boosted export earnings aside from maintaining food and nutritional security. Between 2008 and 2009, the world experienced a food crisis, which increased food prices, and agriculture became the major issue for world politics and policymakers once more (Anik et al., 2017). The global food system's agricultural output is dependent on it, says the Food and Agriculture Organization (2019), as it feeds a growing population and sustains economic prosperity. Agricultural resources, such as land, labor, and capital, are used to create food and other agricultural products to determine efficiency. Growth in the agriculture sector is approximately two to four times more effective at raising the incomes of the lowest-income individuals than growth in other industries. Most developing nations rely on agriculture as their primary means of income therefore, increased productivity in agriculture can increase farmer income and lower rural poverty. According to Koirala et al. (2016), rice is one of the most significant agricultural products in the Philippines, thus a

significant source of revenue for many Filipino farmers. The farms used for agriculture in the Philippines are diverse. However, most Filipino farms continue to use traditional agricultural methods, as small farmers manage big estates, but many other farmers run small subsistence farms. The Philippines' land resource is the primary constraint on cultivating rice and other crops and the reason for rising imports (Koirala et al., 2016). Economic theory suggests that greater land ownership may be necessary for farmers to have access to the credit and land they require to employ improved agricultural methods.

According to a study by Urrutia et al. (2018), 32% of Filipino workers worked in agriculture-related industries in 2013. Several challenges and problems currently affect Philippine agriculture, including moderate increases in total factor productivity and factors of production, a decline in labor share, fixed allocation of land, and a need for more capital in the agri-food system (Briones, 2021). The Philippines' agriculture grew steadily in the 1960s and 1970s, according to the World Bank (2021), owing mainly to the rapid adoption of new technologies, including Green Revolution seeds. However, due to another price increase, this trend slowed down in the 1980s and 1990s before growing in the 2000s. The growth rate dropped again in the 2010s, remaining below two percent. According to the Philippine Statistics Authority [PSA] (2023), at this time, the country's leading source of agricultural growth was the poultry industry, while crop production remained stagnant. Unfortunately, the fishing industry has been declining in recent years. To solve these difficulties, economic conditions for the agri-food system must be improved by increasing investment and agricultural production. This can be accomplished through policies encouraging research and development, infrastructure development, financial access, and market-oriented reforms.

Furthermore, crop diversification beyond the conventional five crops (palay, corn, coconut, sugarcane, and banana) is required to boost production and competitiveness. This study aimed to assess how economic factors like labor, capital, and land affect agricultural output in the Philippines. In this study, the researchers have investigated whether there is any correlation between these agricultural inputs and the

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Philippines' agricultural productivity.

This study's primary goal was to determine the relationship between agricultural inputs and productivity in the Philippines, specifically about agricultural land, labor, and capital. It also aimed to determine the distribution of agricultural inputs in the country and how each contributes to the sector's productivity. This study broadened and compared the findings of other studies, focusing on the economic factors affecting the productivity of the agriculture sector. The data was collected from multiple sources, particularly from the Philippine Statistics Authority (PSA) and the World Bank, which covered 22 years, from 2000 to 2021. Policies may be derived from the findings of this study as it is intended to provide the policymakers with how the economic factors in agriculture affect the sector's productivity and the national economy in general.

2. Literature

A. *Agricultural Productivity and its Inputs of Production*

The complexity and external factors influence the relationship between agriculture and Gross Domestic Product in most developing countries. Agriculture may be productive; nevertheless, its contribution to GDP can be limited by various issues such as poor productivity, insufficient access to capital and markets, and inadequate infrastructure. Furthermore, factors like trade policy, institutional capability, and social dynamics might complicate the relationship between agricultural land and GDP (Reidsma *et al.*, 2011). Furthermore, according to Koirala *et al.* (2016), most developing countries rely on agriculture since it is farmers' primary income source. Improving agricultural productivity is a critical approach in the fight against farmer poverty. While some farmers have adopted commercial farming strategies, many still rely on traditional farming methods. The Philippines continues to experience difficulty producing enough rice to meet the demands of its population, resulting in a food security issue, even though the Green Revolution occurred half a century ago. Inadequate land reform measures, technical inefficiencies, and farmer production decisions contribute to this problem. High production costs, insufficient government support, and diminishing farm productivity have contributed to an agricultural dilemma in the Philippines.

Productivity in Tanzania's agriculture is now recognized as a significant growth engine that alleviates poverty and fosters international development (Christiaensen *et al.*, 2017). Many developing nations receive a substantial part of the agriculture sector's Gross Domestic Product (GDP). Despite being both an agricultural and developing country, the Philippines' whole agriculture sector, as of 2013, accounted for about 10% of the nation's total GDP. In the same year, there was a risk that unemployment and poverty could arise from the Philippines' agricultural sector. Nearly 60% of the population relies on agriculture for employment and income, but with extremely low productivity, which leads to low revenue among farmers (Urrutia *et al.*, 2018). The Philippines' economy underwent a structural change, much like the economies of other middle-

income nations that were quickly urbanizing and rising in population. Although structural change has been lagging in the Philippines, this suggests that due to underutilization, agriculture needs to make its total economic contribution to the national and rural economies (World Bank, 2020).

The Gross Domestic Product (GDP) of many emerging nations is significantly influenced by agriculture. However, the Philippines' agriculture industry is experiencing issues that might lead to unemployment and poverty. Farmers have low productivity, which results in low revenue, and with agriculture providing jobs and income for about 60% of the population, this is the reason for concern (Urrutia *et al.*, 2018). Moreover, according to Liu *et al.* (2020), despite ongoing economic progress in South and Southeast Asian countries, higher GDP per capita levels were linked to slower growth in agricultural total factor productivity, highlighting the need to address the paradoxical situation of high agricultural employment but slow productivity growth in some areas. On the other hand, Fernandez *et al.* (2022) found that in the Philippines, the crop and fisheries sub sector significantly contributes to the agricultural sector's percentage share of the GDP growth rate, while the livestock and poultry sectors contribute less. Furthermore, the author suggested that increasing output production in these sub-sectors may boost the agricultural sector's percentage contribution to GDP in the Philippines.

When viewed alongside patterns of total factor productivity (TFP), the idea of a decrease in agricultural output has not held up. By comparing the overall agricultural output to the total amount of land, labor, capital, and other intermediate inputs utilized in production, TFP employs systems view on productivity. The aggregate outputs and inputs' average growth rates are assessed to calculate the TFP's growth rate. The mean productivity of the inputs (TFP) increases if the total output grows faster than the total input. In simpler terms, each output unit is produced using fewer total inputs if total output grows quicker than total input (Fuglie, 2018).

B. *Agricultural Land*

Globally, many degraded landscapes and unsustainable agricultural methods can increase food insecurity and poverty levels. Due to their reliance on crop production and sensitivity to economic shocks, smallholder farmers are particularly vulnerable and more likely to use unsustainable agricultural practices (Harman *et al.*, 2015). Agricultural land use has the potential to create revenue for farmers and rural communities, which can lead to an increase in consumer spending and stimulate local economies, ultimately contributing to GDP growth. Sustainable farming techniques can also support environmental sustainability and the preservation of natural resources, which may boost economic output in future generations (Jiang *et al.*, 2013). Growing the extent of reclaimable farmland is an effective strategy to increase agricultural productivity (Wang, 2022). As stated by Kanianska (2016), the production of agricultural necessities is significantly impacted by the use of land for agriculture. Agricultural production is greatly decreased when land is farmed for the goal of land development. Moreover, according to Jin *et al.* (2015),

they clarified that changes in the way land are used might pose serious problems for meeting agricultural needs. According to Bhat (2013), how land is utilized for agriculture significantly impacts how productive the agriculture sector is. It influences soil quality, water availability, and other essential factors for agricultural development. Land misuse or overuse can cause soil degradation, erosion, and diminished fertility, resulting in lower crop yields and poorer agricultural productivity.

Moreover, optimal and sustainable land usage can increase crop yields and enhance agricultural productivity. Due to this, understanding the agricultural land use pattern is critical for ensuring food security, addressing land use concerns, and optimizing land usage while preventing harm to it. However, Arowolo and Deng (2017) found that in Nigeria, there is a negative correlation between the expansion of cultivated land and GDP per capita, indicating that farmers may be moving to cities for better wages, leading to less land being converted to agricultural use. Investment in other sectors with higher land productivity is suggested as income rises, as there is a declining possibility of land being converted for agriculture. Nonetheless, this study's findings were limited to Nigeria and may not apply to other countries.

A study by Adamopoulos and Restuccia (2020) discovered that land reform reduced average farm size and agricultural output between 1989 and 1993. It has been proven that it can influence agriculture. Due to improved technology and management methods, smaller farms may be more productive. The average size of cash and food crop farms decreased as labor productivity increased. The average size of all farms decreased by 18%, while labor productivity increased by 45%, indicating that smaller farms can be more productive. Adamopoulos and Restuccia (2020) found that CARP has lowered average farm size by 34%, agricultural production by 17%, and the percentage of people without land by 20% using farm household panel data. Inadvertently, the insufficient implementation of the CARP has postponed a more serious effect on output. Production would have decreased by 26% if the project had been carried out in its entirety, according to estimates.

The Food and Agriculture Organization (2020) estimates that there would be 12.44 million hectares of arable land in the country. This area cannot accommodate farm expansion since farm sizes have decreased as rural populations have grown. A farm's average size was 1.29 hectares in 2012. Like fragmentation, the Comprehensive Agrarian Reform Program (CARP) has made it more challenging to achieve economies of scale by dividing farmlands and suppressing land rental markets in the direction of reconsolidation of enterprises.

A study by Bravo (2017) revealed that the rate of urbanization in the Philippines has stabilized during the past 20 years. However, it has slowed, indicating that the rural population is growing faster than the urban population. Indicators of the effects of urbanization include the declining economic worth of agriculture in the nation and the marginal loss of employment in the sector. Urbanization, which has caused agricultural regions to be converted to urban use, has resulted in smaller and more fragmented farm parts.

Urbanization forced significant land conversion, which led to a severe fall in crop-producing areas and changed the agricultural landscape of the Metropolitan Manila region. Furthermore, it has increased pressure on urban fringes, prompting unavoidable changes in land use. In their study, Estacio et al. (2022) also noted that during the past few decades, conventional land alteration techniques and an increase in long-term agricultural abandonment have led to large-scale changes in the land cover of mountainous agricultural landscapes.

C. Agricultural Employment

Agricultural employment is the work people do in the agricultural sector, such as farming, ranching, forestry, and fishing. It is a crucial driver of agricultural output because it provides the labor needed to produce food and other agricultural products. Agricultural employment also generates income for rural households, which can help to reduce poverty and improve living standards (Dethier & Effenberger, 2011). In developing countries, agricultural employment is often the primary source of income for most of the population. As a result, agricultural employment plays a vital role in poverty reduction and economic development.

Meanwhile, agricultural employment in the Philippines presents various drawbacks, such as lower productivity and daily wages compared to industry and services. Briones (2017) observed that compared to other occupations, agricultural laborers are often older, male, and less educated. Even though there is a steady trend towards agricultural workers getting older and having higher levels of education, their usual characteristics tend to remain constant over time. Furthermore, the sector with the highest visible underemployment rate is agriculture, where the rate has been declining in other sectors since 2007, but it is still significant and consistent there. Nevertheless, many impoverished households depend on agriculture as their primary income source. This implies that rural households reliant on agriculture may experience lower incomes and potentially diminished well-being than those engaged in other sectors (Briones, 2020).

The difference in employment between the agricultural and non-agricultural sectors, particularly in emerging nations, was found by Gollin et al. (2014) based on national accounts data. His study indicated a substantial misallocation of labor across sectors at first glance. According to Fuglie et al. (2019), the employment gap between agriculture and other sectors that is seen in macro statistics may be explained by potentially significant, systematic measurement errors based on empirical shreds of findings from three distinct global regions: China in East Asia, India in South Asia, and four nations in East Africa. These results provide a peek into the reasons why agricultural household members might choose to stick with farming: the benefits of their labor are on par with their available options. Moreover, changes in economic growth, demographic structure, and the slower expansion of the working-age population, according to Xinghua (2014), all contribute to a lack of general labor supply. In addition, the industrial sector siphoned off a component of the agricultural labor force to support its rapid expansion, which caused supply to rise more

slowly than demand. Widespread labor shortages, as well as increasing and convergent wages, have been caused by changes in the supply and demand of the labor force. Briones (2017) suggested that the agriculture industry may face challenges related to poor production and low wages, as agricultural workers exhibit lower output and receive lower basic wages than workers in other industries.

Moreover, sustaining the recent growth in worker distribution across all sectors could be challenging. Onegina *et al.* (2020) highlighted the need of lowering the time needed for food production and raising the output per worker in agriculture as essential components for rising economic output and societal development. Several factors contribute to the decline in agricultural employment, including technological advancements that enhance labor productivity, reduced demand for additional workers, a shift towards informal employment like unpaid family labor, better job prospects in non-agricultural sectors, and increased vulnerability of the agriculture sector due to weather-related disruptions and political instability. Despite these factors causing a decrease in agricultural employment, it is crucial to recognize that agriculture remains vital in many developing countries. It plays a significant role in economic output through exports and ensures food security, as highlighted by the International Labour Organization (2020).

The necessity of enhancing the output per worker in agriculture is determined by the state's engagement in agricultural production, as indicated by Shakulikova *et al.* (2016), to carry out public tasks effectively. Agriculture needs to be reformed, and how labor is organized needs to change. In order to improve labor productivity in the agriculture sector, the sector must expand, and new employment must be created. The government should play a significant part in agricultural reform by changing the legal system, especially the labor laws.

D. Capital Formation in Agriculture

Agricultural innovation progressively replaces physical work and draft animals and supports agrarian output as farming motorization propels. In any case, economies of scale assume a considerable part in the financial advantages of utilizing machines (Quan & Doluschitz, 2021). A country needs capital accumulation to achieve its economic development goal. One way to gauge economic development is by creating capital equipment on a scale that will increase output in industry, plantations, mining, and agriculture. An increase in a country's physical capital stock is equivalent to or necessary for expenditure on social and financial infrastructure.

Formation of gross fixed capital consists of gross domestic investment made by public and private investors. The total public investment includes investments made by the government and publicly traded businesses. Gross domestic investment is the sum of changes in net inventories and gross fixed capital formation. The production of tangible goods like structures, equipment, and machines, as well as intangible goods like top-notch healthcare, scientific traditions, and research products, can result from a nation's capital growth (Shuaib & Ndidi, 2015).

The Gross Capital formation, like in India, enhances

agriculture's labor output and income. Public sector investment in capital has played a significant role in developing irrigation, roads, and power infrastructure. However, the share of public gross capital formation in agriculture has consistently been lower than private gross capital formation, accounting for approximately one-fourth of the total agricultural investment. The study reveals that the distribution of capital investments in agriculture varies across states, which has implications for farm income. Results suggested that capital formation is vital for promoting agricultural growth and increasing agricultural output (Bathla, 2014). Furthermore, Yeboah (2016) emphasized that it was observed that the agriculture sector's gross capital formation had an impact on agricultural output. However, Hussain (2016) refuted the findings and provided an explanation for the lack of connection between the provided factors.

Multiple regression analysis was used in the study by Kanu and Ozurumba (2014) to look at how capital formation affects Nigeria's economic production. It was discovered that the GDP, total exports, and total investment in fixed assets all showed significant long-term correlations with economic production. The formation of gross fixed capital took time to impact economic production. Mechanization, which calls for capital investments, is a significant factor in raising output per worker. However, agricultural capital formation has been minimal. It is now impossible to adequately finance fixed and working capital requirements since formal finance has disproportionately moved outside the agricultural sector (Briones, 2021). Over time, the government's role in providing credit to the Philippine agricultural sector has changed, as Geron and Casuga (2012) mentioned. From the perspective that credit is an input to production and must be offered to farmers to improve agricultural production, it has evolved to the position that credit is now seen as a financial service that farmers require. As a result, they should have access to credit. According to Galang (2020), Small farmers and fishermen who accumulate debt can get legal loans in 62% of cases—in addition to private capital, public capital stock—mainly rural infrastructure—significantly influences agricultural output. The country has not made enough investments in its infrastructure, unfortunately. According to Llanto (2012), poor rural infrastructure is a factor in the underwhelming output production of agriculture. The government must favor the provision of public goods over the sale of private commodities.

The Organization for Economic Co-operation and Development (2017) stated that budgetary plans include input subsidies for agricultural insurance, equipment, irrigation services, and seeds. However, the support for public goods was just 4% of the total value of agricultural produce. Capital formation plays an essential role in a country. Capital accumulation in economic sectors like agriculture can lead to higher economic output and more employment opportunities (Ernawati, 2021; Tijani *et al.*, 2015). In Nigeria, there is a long-term relationship between the variables because government capital accumulation is positively and significantly correlated with economic production. (Idoko & Jatto, 2018; Tijani *et al.*, 2015). Moreover, Morales *et al.* (2022), suggested that

improving agricultural machinery and technology, as well as providing training programs on sustainable farming, are two ways to strengthen the agricultural sector and resolve this issue.

The level of agricultural output is significantly influenced by capital formation in the sector. It would encourage farmers to increase their output and compete on the global market if there was an increasing capital accumulation in the agricultural sector's various components—including infrastructure, technological development, distribution systems, and other crucial economic fundamentals. Timothy *et al.* (2015) also reported that investing in agricultural capital positively correlated with agricultural output. Agricultural capital formation has positively affected short-term agricultural output growth rates. Umair *et al.* (2017) also discovered that agricultural accumulation and product pricing play a significant role in increasing agricultural output. Moreover, a long-term association between agricultural capital, agricultural product prices, and Pakistan's total agricultural output shows a favorable relationship (Chandio *et al.*, 2016).

E. Theoretical Framework

The primary goal of production is to convert raw materials into products. According to several economists, production is any economic activity other than consumption. Any commercial action not resulting in the actual purchase is regarded as a producing activity. Time and space are used to carry out the production process. It is a flow concept based on the production rate per unit of time. The quantity of the produced good, its quality, and its temporal and geographic dispersion are all factors that the production process takes into account. Any activity that makes the quantity, forms, and distribution of items on the market more similar to consumer demand patterns can be referred to as a manufacturing process. The resources or inputs employed in the manufacturing process are referred to as "production factors" by economists. Typically, various potential inputs are divided into four or five categories, including land, capital goods, labor, and natural resources (natural capital). Since management and entrepreneurial skills are a subclass of labor services, a fifth category has been introduced. Capital goods are products that have undergone a manufacturing process. According to some scholars, technology was also a component of the production process. All of these variables are modifiable by management for long-term output.

On the other hand, short-term production typically assumes that at least one production factor must be permanent. A fixed factor of production is one whose quantity cannot be easily changed. Examples include heavy machinery, suitable production regions, and essential management staff. Production variables include the consumption of agricultural goods, transportation services, and raw materials, whose amount of use is easily modifiable. The economic scope of a firm determines the maximum number of items that can be produced in the near term. No scale restriction applies to long-term production (Diaz, 2022).

3. Method

A. Research Design

A quantitative descriptive-correlational method was used in this study to analyze the relationship between the variables under investigation. Secondary data was used to examine agricultural productivity, land, labor, and capital. This publicly available time-series annual data from 2000 to 2021 was utilized as this was the time frame for which data was available. The data were collected from multiple sources, including the Philippine Statistics Authority (PSA), and the World Bank.

B. Model

Multiple regression analysis was utilized in the study to examine the relationship between Agricultural Productivity and its three independent variables. After creating a regression equation to simulate the relationship between the independent and dependent variables, the researchers assessed how much each independent variable contributed to the explanation of the dependent variable.

$$AFF = \beta_0 + \beta_1ALD + \beta_2AE - \beta_3GCF + \varepsilon \quad (1)$$

where, AFF is the agriculture, forestry, and fishing share of GDP, ALD is the agricultural land, AE is the agricultural employment, and GCF is the gross capital formation on agriculture. AFF represents agriculture, forestry, and fishing share of GDP, a proxy variable measured by the percentage share of the agriculture sector to the country's GDP. ALD represents the Agricultural Land as a proxy variable measured by the percentage of land area in the Philippines utilized by the agricultural sector. AE represents Agricultural Employment as a proxy variable measured by the percentage of total employment that works for the agriculture sector. GCF represents Gross Capital Formation as a proxy variable measured by the yearly growth rate of agricultural machinery, which includes used agricultural assets.

4. Results and Discussion

This study sought to determine and assess the contribution of agricultural variables to the change in the Philippines' agricultural GDP share as a percentage of GDP from 2000 to 2021.

To understand the relationship among the three independent variables (agricultural land, agricultural employment, and gross capital formation on agriculture) and the dependent variable (agricultural productivity), multiple regression analysis was employed in this study. Table 1 displays the results of the Ordinary Least Squares Multiple Regression Analysis. Table 1 provides a summary of the model and shows how much of the variance in the dependent variables can be explained by regression lines.

The agricultural productivity of the Philippines was the dependent variable in the employed method, whereas the independent variables were Gross Capital Formation on Agriculture, Agricultural Employment, and Agricultural Land. Due to their p-values being less than 0.05, with 0.0006 for

Table 1
Ordinary Least Squares, dependent variable: AFF

	Coefficient	Std. Error	t-ratio	p-value	
Constant	-22.6535	6.99637	-3.238	0.0046	***
AE	0.474726	0.0741314	6.404	<0.0001	***
GCF	-0.856885	0.624268	-1.373	0.1867	
ALD	0.513147	0.123165	4.166	0.0006	***
Mean dependent var	12.41818		S.D. dependent var	1.783959	
Sum squared resid	4.413687		S.E. of regression	0.495182	
R-squared	0.933959		Adjusted R-squared	0.922952	
F(3, 18)	84.85291		P-value(F)	8.17e-11	

agricultural land and <0.0001 for agricultural employment, these results are significant for agricultural productivity. Nonetheless, the p-value for gross capital formation in agriculture is 0.1867, higher than 0.05, and has no impact on agricultural productivity.

Positive coefficients for the area of agricultural land and the employment rate in agriculture show a direct relationship with the dependent variable. This suggests that agricultural land with a coefficient of 0.513147 means that there will be a 0.513147% increase in agricultural production for every percent increase in agricultural land area. An efficient way to raise agricultural productivity is to expand the area of reclaimable farmland (Wang, 2022). Furthermore, Kanianska (2016) clarified that the production of agricultural requirements is greatly impacted using land for agriculture. According to Jin et al. (2015), farming agricultural land for the purpose of building up land significantly reduces agricultural yield. Furthermore, he explained that alterations in land usage may result in significant issues for the fulfilment of agricultural requirements. Conversely, the correlation for agricultural employment is 0.4657, meaning that a rise in the percentage of total employment in agriculture corresponds to a 0.4657 percent increase in agricultural output. As stated by Urrutia et al. (2018), there is a positive correlation between agricultural employment and production. They said that the Philippines would produce more agricultural goods so long as there is a rise in employment in the agricultural sector. Briones (2017), on the other hand, hypothesized that as agricultural workers produce less and get lower base pay than those in other industries, the agriculture sector may have difficulties with low agricultural productivity. Moreover, agricultural production is not impacted by the Gross Capital Formation on the agriculture sector. The study by Hussain (2016) provided support for this outcome. Their explanation was that there was no correlation between agricultural production in emerging nations and gross capital formation when pooled OLS was used. The findings of this investigation, however, are at odds with those of Yeboah (2016) and Urrutia et al. (2018). The influence of gross capital creation in the agriculture sector on agricultural production was explored.

The probability for agricultural land area is 0.0006, which is less than the alpha threshold of 0.05, as table 1 also demonstrates. As a result, the null hypothesis is rejected. The p-value for agricultural employment is less than the alpha threshold of 0.05, meaning that the null hypothesis is also rejected. On the other hand, for agricultural capital, the null hypothesis is accepted since it can be viewed as insignificant,

with a probability of 0.1867 which is greater than 0.05.

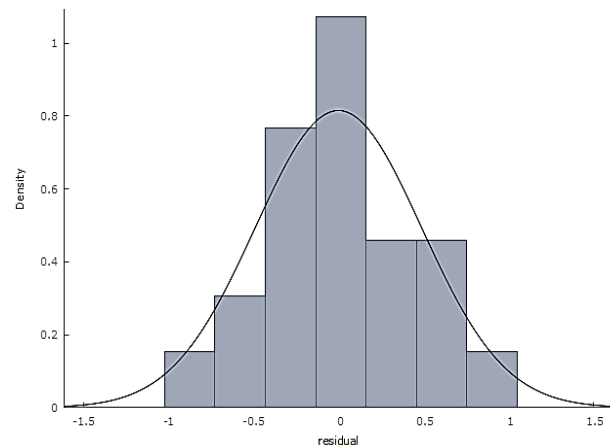


Fig. 1. Result of normality test

Table 2
Statistics of variables

Series: Residuals	
Sample	2000-2021
Observations	22
Mean	-8.07435e-016
Maximum	0.75602
Minimum	-0.72726
Std. Dev	0.489256
Jarque-Bera	2.51158
Probability	0.284851

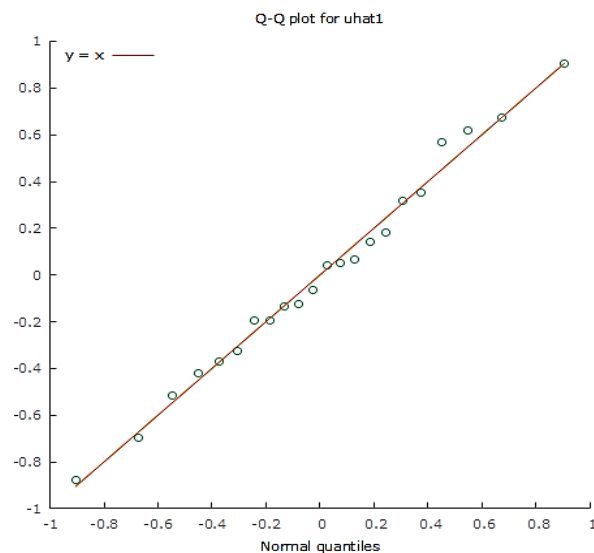


Fig. 2. Scatter plot result

Figure 1 displays a probability of 0.2849, which is higher

than the 0.05 threshold, based on the results. This indicates that, regarding the dependent variable, the independent variables have a normal distribution. The Q-Q plot may also be used to identify any outliers in the data and assess if it is regularly distributed. While there are no outliers, as demonstrated in Figure 2, this indicates that the dependent and independent variables have a normal distribution.

5. Conclusion

With a wide variety of crops and agricultural pursuits, the Philippines is an agrarian nation. Major crops grown in the nation are bananas, rice, corn, sugarcane, coconuts, and a range of fruits and vegetables as well as cattle products. The Philippines' economy and food security depend heavily on agriculture, employing a significant portion of the labor force. However, natural calamities like typhoons and land reform difficulties have affected the agriculture sector and made an impact on productivity. One of the most significant approaches in the fight against farmer poverty is increasing agricultural productivity. Many farmers continue to use conventional farming techniques, even though some have embraced commercial farming strategies. Even though the Green Revolution happened fifty years ago, the Philippines still struggles to produce enough rice to meet the demands of its population, which leads to a problem with food security. Therefore, increasing agricultural production must happen if the goal is to reduce rural poverty and raise farmers' income. Most people in rural areas rely on agriculture for both employment and income, therefore low production means low revenue for farmers. This issue is exacerbated by farmer production decisions, technical inefficiencies, and insufficient land reform initiatives. The Philippines is facing an agricultural predicament due to high production costs, inadequate government support, and declining farm productivity.

Increasing agricultural productivity is crucial for rural livelihoods, economic growth, and food security. The policy implication of this study suggests that funding for research and development, extension services, infrastructure development, financing availability, land reform, education and training, smallholder support, and technology adoption are key factors for raising the productivity of the nation's agriculture sector which results in potentially opening new economic opportunities and giving the nation a competitive edge.

Governments should fund agricultural research and development to create high-yield crop varieties, enhance livestock breeds, and promote sustainable farming methods. Providing information on new technologies, technical support, and training can significantly boost productivity. Improving infrastructure can reduce post-harvest losses, increase market accessibility, and raise output. Offering credit and financial services to farmers, especially smallholders, is crucial. Contributing to agricultural education and training programs will equip the next generation of farmers with modern farming skills. Crafting policies to assist smallholder farmers, who often lack access to resources and modern technology, is essential. Farmer organizations, cooperative development, and microfinance can be valuable in this context. Encouraging the

use of advanced agricultural technologies, such as biotechnology, precision agriculture, and information and communication technology (ICT) tools, can enhance efficiency and productivity.

References

- [1] Arowolo, A. O., & Deng, X. (2017). Land use/land cover change and statistical modelling of cultivated land change drivers in Nigeria. *Regional Environmental Change*, 18(1), 247–259.
- [2] Abdulai, A., Owusu, V., & Goetz, R. (2011). Land tenure differences and investment in land improvement measures: Theoretical and empirical analyses. *Journal of Development Economics*, 96(1), 66–78.
- [3] Adamopoulos, T., & Restuccia, D. (2020). Land Reform and Productivity: A Quantitative Analysis with Micro Data. *American Economic Journal: Macroeconomics*, 12(3), 1–39.
- [4] Anik, A. R., Rahman, S., & Sarker, J. R. (2017). Agricultural productivity growth and the role of capital in South Asia (1980–2013). *Sustainability*, 9(3), 470.
- [5] Bathla, S. (2014). Public and private capital formation and agricultural growth in India: State level analysis of inter-linkages during pre- and post-reform periods. *Agricultural Economics Research Review*, 27(1), 19.
- [6] Bhat, M. M. (2013). Agricultural land-use pattern in Pulwama district of Kashmir Valley. *International Journal of Economics, Business and Finance*, 1(5), 80-93.
- [7] Bravo, M. R. (2017). Urbanization in the Philippines and its influence on agriculture. *Sustainable landscape planning in selected urban regions*, 97-110.
- [8] Briones, R. M. (2021). Philippine agriculture: Current state, challenges, and ways forward. *Think Asia*. <https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsprn2112.pdf>
- [9] Briones, R. M. (2020). Agricultural employment and the rural household: A characterization for selected provinces in the Philippines. <https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps2017.pdf>
- [10] Briones, R. M. (2017). Characterization of Agricultural Workers in the Philippines (2017-31). *Philippine Institute for Development Studies*. <https://www.pids.gov.ph/publication/discussion-papers/characterization-of-agricultural-workers-in-the-philippines>
- [11] Chandio, A. A., Jiang, Y., Rehman, A., Jingdong, L., & Dean, D. (2016). Impact of government expenditure on agricultural sector and economic growth in Pakistan. *American-Eurasian J. Agric. & Environ. Sci*, 16(8), 1441-1448.
- [12] Chant, S. (1997). Women-Headed Households: Poorest of the Poor?: Perspectives from Mexico, Costa Rica and the Philippines. *IDS Bulletin*, 28(3), 26–48.
- [13] Christiaensen L., Weerdt J., Ingelaere B., Kanbur R. (2017): *Migrants, Towns, Poverty and Jobs: Insights from Tanzania*. Policy Research Working Paper 8340, World Bank, Washington, DC.
- [14] Diaz, P. (2022). Selected Factors Affecting the Subsectors of the Philippine Agriculture: A Panel Regression Analysis. *International Journal of Academe and Industry Research*, 3(3), 43-64.
- [15] Dethier, J.-J., & Effenberger, A. (2011). Agriculture and development: A brief review of the literature. doi:10.1596/1813-9450-5553
- [16] Ernawati, E., Tajuddin, T., & Nur, S. (2021). Does Government Expenditure Affect Regional Inclusive Growth? An Experience of Implementing Village Fund Policy in Indonesia. *Economics*, 9(4), 164. MDPI AG.
- [17] Estacio, I., Basu, M., Sianipar, C. P., Onitsuka, K., & Hoshino, S. (2022). Dynamics of land cover transitions and agricultural abandonment in a mountainous agricultural landscape: Case of Ifugao rice terraces, Philippines. *Landscape and Urban Planning*, 222, 104394.
- [18] FAO. (2019). *The future of food and agriculture – alternative pathways to 2050*. Rome, Italy: FAO.
- [19] Fernandez, A.A.M., Gersaniba, I.M.M., Tan, W.J.N. & Rosete, M.R.L. (2022). Analysis of agricultural sub-sectors growth rate contribution to agriculture's percent share on Philippines' GDP. *International Journal of Social Science and Management Studies*, 1(3), 29-44.
- [20] Food and Agriculture Organization (FAO). (2020). *FAOStat*. Rome, Italy: FAO. <http://faostat.fao.org>
- [21] Fluglie, K. O. (2018). Is agricultural productivity slowing? *Global food security*, 17, 73-83.

- [22] Fuglie, K., Gautam, M., Goyal, A., & Maloney, W. F. (2019). Harvesting prosperity: Technology and productivity growth in agriculture. World Bank Publications.
- [23] Galang, I.M.R. (2020). Boosting agricultural productivity through parcelization of collective certificate of land ownership awards. PIDS Discussion Paper 2020-26. Quezon City, Philippines: Philippine Institute for Development Studies.
- [24] Geron, M. P. S., & Casuga, M. S. (2012). Credit Subsidy in Philippine Agriculture. PIDS.
- [25] Giang, M. H., Xuan, T. D., Trung, B. H., & Que, M. T. (2019). Total factor productivity of agricultural firms in Vietnam and its relevant determinants. *Economics*, 7(1), 4.
- [26] Gollin, D., Lagakos, D., & Waugh, M. E. (2014). The agricultural productivity gap. *The Quarterly Journal of Economics*, 129(2), 939-993.
- [27] Gui, J., Li, Z., Wang, Z., Chu, X., & Li, Z. (2015). Impact of land-use induced changes on agricultural productivity in the Huang-Huai-Hai River Basin. *Physics and Chemistry of the Earth, Parts a/B/C*, 79–82, 86–92.
- [28] Harman Parks, M., Christie, M. E., & Bagares, I. (2015). Gender and conservation agriculture: constraints and opportunities in the Philippines. *GeoJournal*, 80(1), 61-77.
- [29] Hwang, J., Paris, T. R., Cabrera, E., & Choi, Y. Y. (2011). A Comparative Study on Women's Role in Intrahousehold Decision-Making in Korean and the Philippine Rice Farming Households. *Journal of Rural and Development*, 34(4), 117–136.
- [30] Hussain, N. (2016). Impact of foreign aid to agriculture sector on agricultural productivity in developing countries in the context of second goal of SDGs. <https://archives.kdischool.ac.kr/handle/11125/31942>
- [31] Idoko, C. U., & Jatto, S. M. (2018). Government expenditure on agriculture and economic growth in Nigeria (1985-2015). *International journal of academic research and reflection*, 6(4), 24.
- [32] International Labour Organization. (2020). Five studies of the Philippine agriculture sector. Technical note on labour inspection and strategic compliance planning for decent work in global supply chains. https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-manila/documents/publication/wcms_843646.pdf
- [33] James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021b). *An Introduction to Statistical Learning: with Applications in R*.
- [34] Jiang, L., Deng, X., & Seto, K. C. (2013). The impact of urban expansion on agricultural land use intensity in China. *Land Use Policy*, 35, 33–39.
- [35] Kanianska, R. (2016). Agriculture and its impact on Land-Use, environment, and ecosystem services. In *InTech eBooks*.
- [36] Kanu, S. I & Ozurumba, B. A. (2014). Capital Formation and Economic Growth in Nigeria, *Global Journal of Human-Social Science: Economics*, 14, Issue 4.
- [37] Koirala, K. H., Mishra, A. K., & Mohanty, S. (2014). The role of gender in agricultural productivity in the Philippines: The Average Treatment Effect (No. 1375-2016-109546).
- [38] Koirala, K. H., Mishra, A. K., & Mohanty, S. (2016). Impact of land ownership on productivity and efficiency of rice farmers: The case of the Philippines. *Land Use Policy*, 50, 371–378.
- [39] Llanto, G.M. (2012). The impact of infrastructure on agricultural productivity. PIDS Discussion Paper 2012-12. Makati City, Philippines: Philippine Institute for Development Studies.
- [40] Liu, J., Wang, M., Yang, L., Rahman, S., & Sriboonchitta, S. (2020). Agricultural productivity growth and its determinants in south and southeast Asian countries. *Sustainability*, 12(12), 4981.
- [41] Mishra, A. K., Khanal, A. R., & Mohanty, S. (2017). Gender differentials in farming efficiency and profits: The case of rice production in the Philippines. *Land Use Policy*, 63, 461–469.
- [42] Morales, G. J., Villaronte, R. K., Yap, M. C., & Rosete, M. A., (2022). The Relationship Between Rural-Urban Migration and the Agricultural Output of the Philippines. *International Journal of Social and Management Studies*, 3(1), 62–74.
- [43] Onegina, V., Megits, N., Antoshchenkova, V., & Boblovskiy, O. (2020). Outcome of capital investment on labor productivity in agriculture sector of Ukraine. *Journal of Eastern European and Central Asian Research (JEECAR)*, 7(1), 12-25.
- [44] Organisation for Economic Co-operation and Development (OECD). (2017). *Agricultural policies in the Philippines*. Paris, France: OECD Publishing.
- [45] Philippine Statistics Authority (PSA). (2021). PSA OpenSTAT. <https://openstat.psa.gov.ph/>
- [46] Quan, X., & Doluschitz, R. (2021). Factors Influencing the Adoption of Agricultural Machinery by Chinese Maize Farmers. *Agriculture*, 11(11), 1090.
- [47] Reidsma, P., König, H., Feng, S., Bezlepikina, I., Nesheim, I., Bonin, M., ... Brouwer, F. (2011). Methods and tools for integrated assessment of land use policies on sustainable development in developing countries. *Land Use Policy*, 28(3), 604–617.
- [48] Shakulikova, G. T., Kozhakhmetova, G. A., Lashkareva, O. V., Bondarenko, E. G., Bermukhambetova, B. B., Baimagambetova, Z. A., & Anafiyeva, Z. (2016). Labor Factor Efficiency in the Agricultural Industry. *International Journal of Environmental and Science Education*, 11(17), 9679-9691.
- [49] Shittu A. M., Odine A. I. (2014): Agricultural Productivity Growth in Sub-Sahara Africa, 1990–2010: The Role of Investment, Governance and Trade. Paper presented at the 17th Annual conference on Global Economic Analysis, Dakar, Senegal.
- [50] Shuaib, I. M., & Ndid, D. E. (2015). Capital formation: impact on the economic development of Nigeria 1960-2013. *European Journal of Business, Economics and Accountancy*, 3(3), 23-40.
- [51] Tijani, A. A., Oluwasola, O., & Baruwa, O. I. (2015). Public sector expenditure in agriculture and economic growth in Nigeria: An empirical investigation. *Agrekon*, 54(2), 76–92.
- [52] Timothy, M., Khazamula, C. P., Francis, A., Tichaona, K. P., Nelson, R. E., & Aluwani, M. (2015). Comparative Impact of Public Expenditure on Agricultural Growth: Error Correction Model for South Africa and Zimbabwe. *Journal of Human Ecology*, 50(3), 245–251.
- [53] Ugwuegbe S. U., & Uruakpa, P. C. (2013). The Impact of Capital Formation on the Growth of Nigerian Economy, *Research Journal of Finance and Accounting*, 4(9), 36-40.
- [54] Umair, K., Chen, H., & Snovia, N. (2017). Comparison of government expenditure and some representative of agricultural product prices and their impact on agricultural growth of Pakistan. *Russian Journal of Agricultural and Socio-Economic Sciences*, 63(3), 79-85.
- [55] Urrutia, J. D., Mercado, J. E., Ebue, K. E. E., Raymundo, F. S., & Nobles, B. G. (2018). Analysis of Factors Influencing Agricultural Productivity in the Philippines. *Indian Journal of Science and Technology*, 11(20), 1–10.
- [56] Wang, X. (2022). Managing land carrying capacity: key to achieving sustainable production systems for food security. *Land*, 11(4), 484.
- [57] World Bank. (2020). *Transforming Philippine Agriculture: During COVID-19 and Beyond*.
- [58] World Bank. (2021). World Bank Open Data. <https://data.worldbank.org/>
- [59] Xinghua, Z. (2014). Demand, Supply and Surplus of Agricultural Labor Force in China. *China Economist*, 9(3), 61.
- [60] Xu, J., Wang, Y., Zhao, X., Etuah, S., Liu, Z., & Zhu, H. (2023). Can agricultural trade improve total factor productivity? Empirical evidence from G20 countries. *Frontiers in Sustainable Food Systems*, 7.
- [61] Yeboah Asumah, Samuel, 2016. "Modelling the Effect of Investment on Agricultural Productivity in Ghana," MPRA Paper 70606, University Library of Munich, Germany.
- [62] Yoo, C. K., Gopinath, M., & Kim, H. (2012). Trade Policy Reform, Productivity Growth and Welfare in South Korean Agriculture. *Applied Economic Perspectives and Policy*, 34(3), 472-488.