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# Productivity and Competitiveness of Garlic Production in Pasuquin, Ilocos Norte, Philippines

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## ABSTRACT

A total of 124 garlic farmers were selected and interviewed to evaluate the productivity and competitiveness of garlic farming in Pasuquin, Ilocos Norte, Philippines. The Technical efficiency (TE) was estimated using a stochastic frontier analysis or SFA based on the Cobb-Douglas production functional form, while the competitiveness of local garlic production was determined based on the ratio between import parity price and domestic resource cost ratio.

The mean TE was 81 percent while the estimated gamma value was 0.92. These values indicate that 92 percent of the variation in garlic output is due to inefficiency factors and that total garlic output can further be increased with efficient use of resources. The analysis further revealed that seed rate and insecticides were statistically significant production factors. The results also show that group membership, farm size, and distance to the farm-to-market road (FMR) were statistically significant. Inefficiency factors and distance to the FMR have positive relationships while group membership and farm size have negative relationships with the garlic output.

Price and cost ratios show that garlic from Pasuquin, Ilocos Norte could not yet compete with imported garlic from China in 2018. However, simulations show that if the Philippines can increase its national average by at least 20 percent (4.08 mt/ha), it can have a competitive advantage in garlic production.

The results of the analyses highlight the need to revisit the output and input policies and programs of the government to increase the productivity and competitiveness of garlic farming in Ilocos Norte. These programs include investing in quality seed, joining farmers' organizations, and providing better farming infrastructure.

**Keywords:** productivity, technical efficiency, Cobb-Douglas production function, competitiveness, domestic resource cost ratio

**JEL code:** Q12, Q17

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## INTRODUCTION

Economists rank productivity as the most critical factor for increased economic growth and development. Productivity is the economy's ability to efficiently use available resources such as land, labor, capital, and business expertise to produce goods and services (CPRP 2014). Growth in productivity ensures efficient use of resources and improvement of real incomes and standard of living of a nation (Baumol, Blackman, and Wolff 1991; World Bank 2019). Furthermore, enhanced productivity and low production cost equate to higher levels of competitiveness (Porter 1990; 2004).

Productivity can be accelerated by the introduction of new technology and/or by improvement in efficiency. However, investments in productivity-enhancing technologies (e.g., R&D infrastructure and human capital) were observed to be very limited in developing countries. Hence, it is not surprising that low productivity is still one of the most important challenges of these nations nowadays (Isaksson, Ng, and Robyn 2005; Bloom et al. 2010; UN 2017; Brown, Ebora, and Decena 2018).

Being one of the most populated yet land-scarce countries, the Philippines may have very limited areas for agribusiness expansion. This, in turn, limits the country's agricultural production. Given this limitation, it is essential to improve productivity as a way of increasing production. The Philippines is one of the developing countries experiencing the repercussions of low productivity. The country is the 13th most populated country worldwide (World Population Review 2020), growing by 1.72 percent from 92.34 million in 2010 to 100.98 million in 2015 (PSA 2020). With the increasing population, the country is under pressure to produce more food and provide income to support the basic needs of its people. Furthermore, since the country is constrained by limited land resources, productivity enhancement is the only option to increase its agricultural production (Pabuayon et al. 2013).

However, low productivity remains a concern of the country (Brown, Ebora, and Decena 2018;

PSA 2021a; PSA 2021b). This can be attributed to limited access to agriculture insurance and credit, low farm mechanization and post-harvest facilities, limited support for agricultural research and development or R&D, and weak extension service in the Philippines (Brown, Ebora, and Decena 2018). And because low productivity is also associated with high production costs, the country is left to resort to importation.

The influx of cheap imports, however, further intensifies the burden of the country's local producers. For one, the native garlic industry has been incurring losses due to cheap imported garlic dominating the local market. Garlic is one of the most popularly cultivated *Alliums* in the Philippines. But relative to its neighboring countries, the Philippines has lower productivity with an average of 3.4 mt/ha/year compared to 27 mt/ha/year of China (Dy 2018). In fact, the country's 2015–2017 average annual production level of 8,547 mt was enough to meet only 11.5 percent of domestic demand for garlic, estimated at 67,366 mt (PSA 2015; 2021a; 2021b). This has led to a massive amount of garlic importation year after year.

The Department of Agriculture (DA) has been undertaking continuing efforts to stabilize garlic prices and to develop and sustain the growth of the garlic industry in the country. Development interventions are focused on the identification of potential garlic production areas, provision of credit and technical support, acquisition of cold storage facilities, market linkage, capacity building of farmers and change agents, tapping information technology, value-adding, and training on agripreneurship (Lubang 2018; DA-Region I 2019). However, evaluating whether local farmers are already at the frontier of their current production and analyzing if the local garlic industry can compete with its imported counterparts has not been given due attention.

This study assesses the import competitiveness of the garlic industry with the accompanying goal of identifying the determinants of garlic farmers' technical efficiency (TE) and productivity. The findings of this study may find their use in the crafting of measures related to the expansion of

garlic production, efficient resource allocation, and appropriate trade policy on garlic importation.

## METHODOLOGY

This study was conducted in the province of Ilocos Norte as it remains the top garlic producer in the country. Ilocos Norte produces 4,823 mt (94%) and occupies 1,856 ha (93%) of the total area planted to garlic in the Ilocos Region in 2019. Among the 19 garlic-producing towns of Ilocos Norte, the municipality of Pasuquin was purposively selected as it contributes almost 40 percent of the province's total production.

A simple random sampling was used for the sample selection. First, the top 16 (out of 32) garlic-producing barangays were purposively selected based on the average annual garlic production volume. Second, the list of garlic farmers was generated using the data provided by the local government of Pasuquin, Ilocos Norte. Third, simple random sampling with proportional allocation was employed to select 124 garlic farmers for the interview.

Data were collected on garlic production such as fertilizer, insecticide, herbicide, seed, labor, garlic area, and the total cultivated area and socioeconomic and institutional variables such as years of education, group membership, and distance to farm-to-market roads (FMR).

## ANALYTICAL FRAMEWORK

### Stochastic Frontier Analysis

Stochastic Frontier Analysis (SFA) was used to estimate the production function and measure the TE of garlic farms. The SFA model accommodates statistical noise, such as measurement error, allowing standard statistical tests to be used. The TE of an individual farm is defined in terms of the ratio of the observed output to the corresponding frontier output, conditioned on the level of inputs used by the farm. TE for each farm was calculated as follows:

$$TE = \text{Exp} \left[ \frac{E(\mu)}{\varepsilon} \right] \quad (1)$$

The stochastic frontier production function was utilized to estimate the maximum production that can be achieved at the application level of the existing production factors and observe the TE level and the factors influencing the technical inefficiency on garlic farming. The stochastic production function is defined as (Bravo-Ureta and Rieger 1991):

$$Y_i = f(X_i; \beta) + \varepsilon_i \quad i = 1, 2, 3, \dots, n \quad (2)$$

where,

- $Y_i$  = output of garlic of  $i$ th farm in kgs/ha;
- $f(X_i; \beta)$  = Cobb-Douglas production function;
- $X_i$  = inputs used in garlic production of garlic (units/ha);
- $\beta$  = parameters to be estimated; and
- $\varepsilon_i$  = composed error term that captures the error term and inefficiency component  $(v_i, u_i)$ .

The  $v_i$  is a random error independent of  $u_i$  and associated with those factors that are beyond the farmer's control. The  $u_i$  is a non-negative random variable truncated half normal  $N(0, \sigma^2 u)$  and is under the farmers' control.

The function determining the technical inefficiency effect is defined in its general form as a linear function of socioeconomic and management factors ( $Z_i$ )

$$u_i = F(Z_i) \quad (3)$$

The TE identifies the most efficient farmer and measures the performance of other farmers accordingly. The TE values range between 0 and 1, or  $0 \leq TE \leq 1$ . If the TE's value is approaching 1, then the garlic farming can be determined as more efficient; if the TE's value is approaching 0, then the garlic farming can be determined as technically inefficient (Coelli et al. 2005). A technically efficient farmer adopts good agricultural practices. However, it must be noted that the TE is estimated based only on the performance of the most efficient farmer within the sample.

## Import Parity Prices

The import parity price (IPP) was used to determine whether it is better to import or utilize locally produced garlic. Import parity level is based on the assumption that imports compete with domestic production at the producer level. In this study, the border price was adjusted to also reflect the marketing cost (e.g., handling, transportation, storage cost) of transporting the product to the wholesale market.

The IPP is estimated using the following formula:

$$P_g = P_b^g + C_{gm} \quad (4)$$

where,

$P_g$  = producer price garlic;

$P_b^g$  = world price at port of entry; and

$C_{gm}$  = marketing margin from the port of entry to the wholesale market.

## Domestic Resource Cost

The competitive advantage of producing different products was analyzed using Domestic Resource Cost (DRC) analysis. This indicator is formally defined as the ratio of the cost in domestic resources and non-traded inputs of producing the commodity domestically to the net foreign exchange earned or saved by producing the good domestically. Following [Ismail et al. \(2009\)](#) and [Catelo and Jimenez \(2017\)](#), the DRC is estimated as:

$$DRC_{ig} = \frac{C_{ig}^d}{P_{ij} - C_{ig}^f} \quad (5)$$

where,

$C_{ig}^d$  and  $C_{ig}^f$  = domestic and foreign input costs, respectively, for country  $i$ 's (Philippines) production of garlic;

$P_{ij}$  = average unit price of country  $i$ 's production of good  $j$  includes non-tradable input costs (e.g., land, labor, capital); and

$P_{ig} - C_{ig}^f$  = domestic value-added generated by the production process.

The DRC ratio (DRCR), on the other hand, was estimated using the formula ([Pabuayon et al. 2013](#)):

$$DRCR = \frac{\text{Domestic Resource Cost}}{\text{Official Exchange Rate}} \quad (6)$$

A DRCR that is greater than 1 means competitive disadvantage, while a DRCR that is less than 1 indicates competitive advantage. Competitive advantage also implies that even with the existence of distortions in the economy, a country's output can still compete in the international market.

## RESULTS AND DISCUSSION

### The Philippine Garlic Industry

In 2019, the country produced 7,256 mt of garlic (PSA), harvested from 2,612 ha with a national average yield of 2.78 mt/ha. The top two major garlic-producing regions in the country are Ilocos Region and MIMAROPA<sup>1</sup> Region. In 2019 alone, the Ilocos Region contributed 66 percent (4,823 mt) to the national production while MIMAROPA contributed 20 percent (1,480 mt) (Table 1).

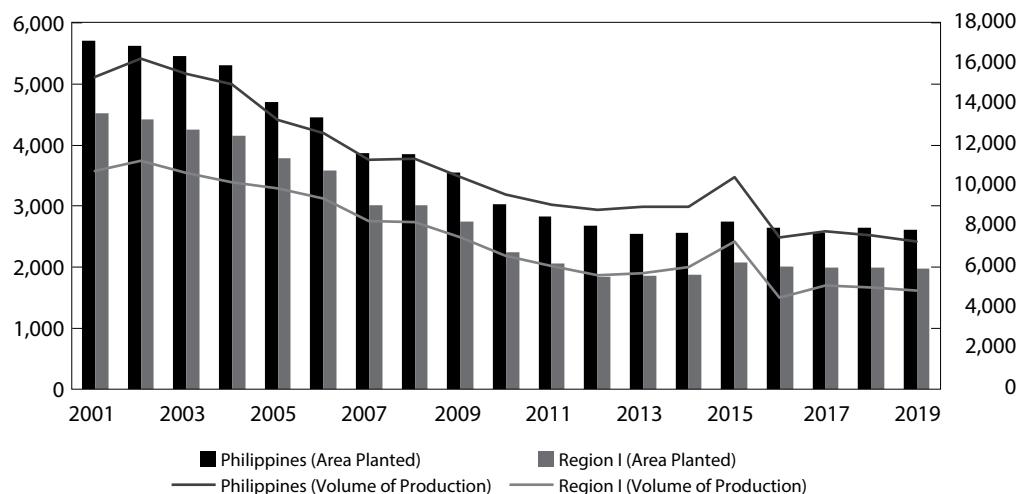
Ilocos Region plays a significant role in the country's garlic industry. The PSA (2021a; 2021b) reports that from 2001–2019, the region accounted for an average of 68 percent and 76 percent of the country's garlic production and area planted, respectively. Thus, the country's garlic production follows the trend of garlic production in Ilocos Region (see Figure 1).

The majority (90%) of Ilocos Region's garlic production from 2001–2019 came from Ilocos Norte ([PSA 2021b](#)). In 2019, Ilocos Norte was the major producer and source of garlic, accounting for 71 percent of the national garlic production volume. It has a total area of 1,969 ha planted

<sup>1</sup> MIMAROPA is an acronym for the provinces of Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon, and Palawan, which comprise the administrative region IV-B in the Philippines.

**Table 1. Garlic production, area planted and yield of Ilocos Region, MIMAROPA, and the Philippines, 2001–2019**

Year	Production			Area Planted			Yield/Hectare		
	Philippines	Ilocos Regions	MIMAROPA	Philippines	Ilocos Region	MIMAROPA	Philippines	Ilocos Region	MIMAROPA
2001	15,364	10,726	1,854	5,707	4,523	524	2.69	2.37	3.54
2002	16,257	11,207	1,893	5,637	4,419	529	2.88	2.54	3.58
2003	15,529	10,615	2,048	5,459	4,261	536	2.84	2.49	3.82
2004	14,999	10,154	2,128	5,312	4,157	541	2.82	2.44	3.93
2005	13,234	9,852	2,110	4,704	3,786	535	2.81	2.60	3.94
2006	12,581	9,378	2,001	4,448	3,585	506	2.83	2.62	3.95
2007	11,285	8,267	1,912	3,863	3,017	499	2.92	2.74	3.83
2008	11,348	8,235	2,049	3,849	3,016	512	2.95	2.73	4.00
2009	10,451	7,478	1,988	3,552	2,741	498	2.94	2.73	3.99
2010	9,563	6,540	2,127	3,039	2,251	489	3.15	2.91	4.35
2011	9,056	6,034	2,161	2,830	2,057	492	3.20	2.93	4.39
2012	8,808	5,623	2,114	2,676	1,839	488	3.29	3.06	4.33
2013	8,986	5,718	2,010	2,539	1,864	301	3.54	3.07	6.67
2014	8,993	6,005	1,795	2,555	1,879	299	3.52	3.20	6.01
2015	10,420	7,263	1,943	2,744	2,075	307	3.80	3.50	6.34
2016	7,469	4,488	1,819	2,647	2,014	292	2.82	2.23	6.23
2017	7,751	5,101	1,719	2,569	1,991	265	3.02	2.56	6.50
2018	7,559	4,983	1,606	2,654	1,987	245	2.85	2.51	6.56
2019	7,256	4,823	1,480	2,612	1,969	241	2.78	2.45	6.15

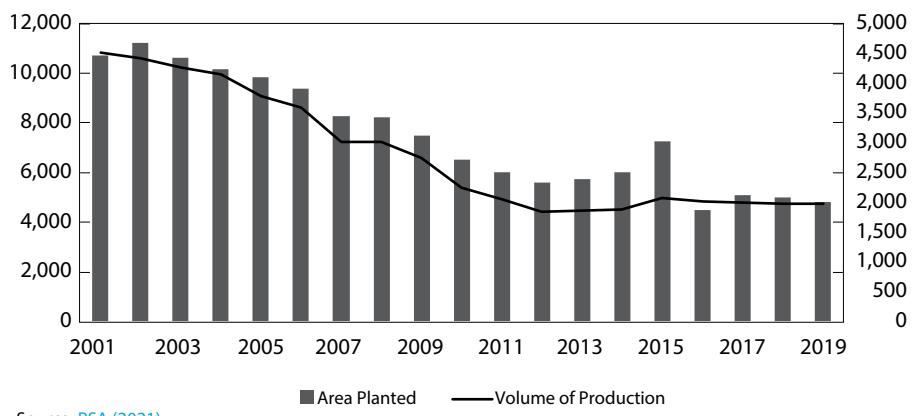
Source: [PSA \(2021a; 2021b\)](#)**Figure 1. Garlic production and area planted in the Philippines and Ilocos Region, 2001–2019**Source: [PSA \(2021\)](#)

to garlic. However, production and area planted have been decreasing in the last 18 years (Figure 2). This resulted to fluctuating farmgate prices from PHP 9.63/kg to PHP 77.16/kg and retail price from PHP 111.28/kg to PHP 246.07/kg. The area planted to garlic declined by 55 percent from 2001–2019 (Figure 3). The decrease in area planted to garlic was due to the low garlic market price because of imported garlic, causing farmers to shift to planting high-value crops. Other reasons identified by [Castañeda et al. \(2020\)](#) are increasing population and conversion of garlic farmlands to residential lots.

Another issue in the garlic industry of Ilocos is the productivity of farms in the province. Although garlic productivity in Ilocos Norte in

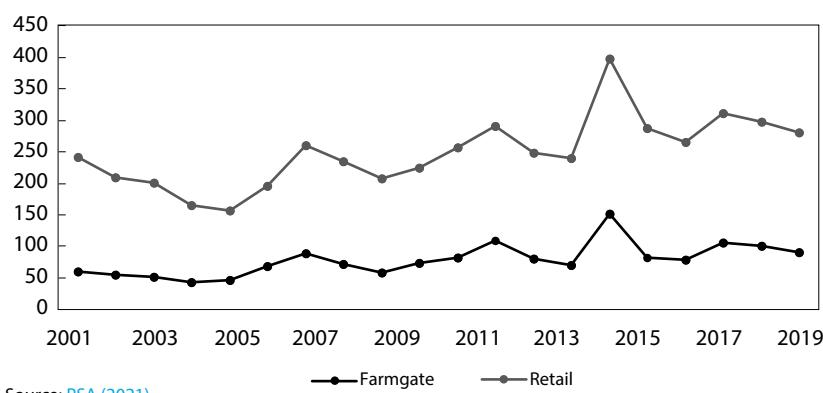
2019 was at 2.51 mt/ha, which was relatively higher than the regional average of 2.40 mt/ha, it was still below the national average of 2.78 mt/ha and a far cry from the best performing region (MIMAROPA) with a yield of 6.15 mt/ha. Good weather conditions that are highly suitable for garlic production and larger mean farm size devoted for garlic production in Occidental Mindoro (1.45 ha in Occidental Mindoro versus 0.15 ha in Ilocos Norte) contributed to better productivity performance of MIMAROPA farmers compared with those in Ilocos Region. Low production and productivity in Ilocos Region have been attributed to high post-harvest losses, the occurrence of pests and diseases, low seed utilization, and poor farmer management ([PSA 2013](#)).

**Figure 2. Garlic production and area planted in Ilocos Norte, 2001–2019**



Source: [PSA \(2021\)](#)

**Figure 3. Farmgate and retail prices of native garlic, 2001–2019**



Source: [PSA \(2021\)](#)

## Socioeconomic and Farm Characteristics of Respondents

The age of the respondents ranged from 22 to 76 years, with an average age of 50. This shows that the cultivation of garlic is relatively common among older farmers. This could be because most young people are engaged in activities and services other than farming or tend to work in urban areas other than in the agricultural sector. Respondents have had between three to 15 years of education, with a mean of 10.96 years. The family size of households ranged from two to eight members, with an average of five members. On average, the respondents have 20 years experience in garlic farming. This indicates that garlic farmers are typically not new to garlic production and garlic cultivation.

Meanwhile, the respondents' farm sizes range from 0.25 to 3.5 ha. Out of the 124 farmer-respondents, only 23 percent (28 farmers) devoted the whole farm to garlic production. This implies that majority of the farmers (77%) practice multi-cropping and fallow cropping. As mentioned above, other than garlic, farmers plant *palay* (rice), onion, and vegetables to reduce the risk of possible losses from pests and diseases if only one crop is planted. In terms of yield, the average Pasuquin farmer harvested 3.4 mt/ha. This figure is higher than the provincial, regional, and national average yields.

The distance from FMRs ranges from 0.25–2 km, with an average of 0.5 km. These FMRs provide farmers the means to bring the inputs and outputs to and from the farm. Farms that are closer to the FMR have recorded low transport costs, efficient delivery of farm inputs, and enhanced agricultural production and distribution.

Membership in a farmers' group or cooperative is one of the most common strategies of farmers to obtain free inputs and access technology. The results of the study show that majority of farmer-respondents (77%) are members of the garlic farmers' group. According to the farmers interviewed, the government agencies that actively provide support/interventions to farmer groups include the DA and the Philippine Council for Agriculture, Aquatic and Natural Resources

Research and Development (or PCAARRD) of the Department of Science and Technology.

## Stochastic Frontier Analysis

Table 2 summarizes the results of the estimation of the ordinary least squares (OLS) and maximum likelihood estimation (MLE) models. The MLE model shows the presence of technical inefficiency effects of garlic farmers in Pasuquin, Ilocos Norte. This is confirmed by the statistical significance of the coefficients of gamma, a measure of the level of inefficiency in the variance parameter. It is estimated at 0.92 and is significant at a 1 percent level of probability. This means that 92 percent of the variation in garlic production is explained by inefficiency. This also implies the domination of the inefficiency components of the error term,  $\varepsilon_i$  ([Kidane and Ngeh 2015](#)). Meanwhile, the generalized likelihood ratio (GLR) test shows that since likelihood ratio (LR) test statistic of 42.15 is greater than a chi-square value of 16.07 ([Kodde and Palm 1986](#)), the null hypothesis that "technical inefficiency is absent in the model (i.e., accept the OLS model)" is rejected. Hence, the MLE model better fits the data of the 124 garlic farmer-respondents than the OLS model.

## Determinants of garlic yield

Among the production factors, the amount of planting materials and fertilizer (kg of Nitrogen [N] per hectare), hired labor, and herbicide significantly influenced garlic yield. The coefficient of planting material means that doubling garlic seed rate per hectare would result in an 11 percent increase in garlic yield, holding other factors constant. This result agrees with the findings of [Adewumi and Adebayo \(2008\)](#) and [Wakili \(2006\)](#). For fertilizer usage, all things remain unchanged, 100 percent increase in the amount of nitrogen fertilizer application per hectare would lead to a four percent increase in yield. The result is in accordance with the findings of [Obwona \(2006\)](#), [Babalola et al. \(2009\)](#), and [Maganga \(2012\)](#). The coefficients of labor and herbicide are also significant inputs to garlic production, which imply that doubling labor input (man-hour/ha) and herbicide (L/ha) would lead to 11 percent and

**Table 2. Maximum likelihood estimates using stochastic frontier model for 124 garlic farmers in Pasuquin, Ilocos Norte, Philippines, 2018**

Variables	OLS Coefficient	MLE Coefficient
<b>Production function</b>		
Constant	6.11***	6.76***
Planting material (kg/ha)	0.21***	0.11**
Fertilizer (kg of N/ha)	0.04	0.04**
Hired labor (man-hour/ha)	0.09	0.11*
Insecticide (ml/ha)	-0.02***	-0.01
Herbicide (gal/ha)	<-0.01	0.01*
<b>Technical inefficiency function</b>		
Constant		0.65**
Education (years of schooling)		-0.03
Group membership		-0.51*
Farm size (ha)		-0.97*
Area planted (ha)		0.56
Distance to FMR		0.52**
Sigma squared		0.26**
Gamma		0.92***
Log likelihood	-15.57	5.51
LR test		42.15
Mean TE		0.81
Number of observations	124	

Source: Field survey (2019)

Notes: \*, \*\*, and \*\*\* = significant at 10 percent, 5 percent, and 1 percent levels, respectively

one percent increase in garlic yield, respectively. The mean efficiency of garlic farmers interviewed was 81 percent, implying that there is considerable room for improvement in garlic production in the area through efficient use of resources.

### **Factors affecting technical inefficiency**

As mentioned above, the MLE model confirms that there are systematic errors within the farmer's control. The lower part of Table 2 presents that among the determinants included in the model, the distance to FMR positively and significantly influenced the level of technical inefficiency at a five percent level. This means that the farther the farm from the nearest FMR, the lower the farmers' technical efficiency. This is consistent with the results of [Rajendran \(2014\)](#) stating that accessibility to infrastructure facilities, such as road, boosts farmers' TE. Based on the interview, acquiring inputs (e.g., fertilizer, chemicals) is very costly for those far from the

FMR. This is because these farmers have to incur higher costs to bring inputs to their farms, disincentivizing them to use the recommended amounts of these inputs.

Results also indicate that group membership and farm size were both negative and significant at a 10 percent probability level. This suggests that TE increases if farmers belong to a farmer group and have bigger landholdings. In terms of membership, the results are consistent with the findings of [Michalek et al. \(2018\)](#), showing that farmers who belong to farmers' organizations have higher added value, employment, labor productivity, and profitability compared to non-members. Membership in farmer groups also helps farmers acquire free/subsidized inputs (e.g., seeds and fertilizer) and have better access to trainings and seminars related to garlic production. The study further highlights that being a member of a farmer group has an impact not only on the type and level of input use and subsequent farm performance but

also on how various inputs are combined in the attempt to maximize farm outcomes. Meanwhile, in terms of farm size, the result agrees with [Olson and Vu \(2009\)](#), who found that large farm sizes are associated with higher TE.

Garlic yield in the study area ranged from 0.75 mt/ha to 6.0 mt/ha with a mean of 3.40 t/ha, showing intra-variation in yield among farmers in the same province. For example, only 67.75 percent of the farmers have a mean TE of at least 81 percent (Table 3). The TE level of the 124 farmers in Pasuquin, Ilocos Norte is also shown in Table 3. As shown in the table, the majority (69%) of the farmers have a TE score of at least 81 percent. The TE scores ranged from a low of 24 percent to a high of 96 percent, with a mean efficiency of 81 percent. The result suggests that, on average, about 19 percent of garlic yield in the province is lost because of inefficiency. But the finding also implies that there is still room to improve garlic productivity by focusing effort on eliminating farm inefficiency. Moreover, in the short run, there is an opportunity to increase garlic production by 15 percent by adopting management practices and techniques used by the most efficient garlic farm in the study area.

**Table 3. Technical efficiency summary of 124 garlic farmers in Pasuquin, Ilocos Norte, 2018**

Technical Efficiency Score (%)	Number of Farmers	Percentage
<50	7.00	5.65
51–60	8.00	6.45
61–70	9.00	7.26
71–80	16.00	12.90
81–90	46.00	37.10
91–100	38.00	30.65
Minimum	24	
Maximum	96	
Mean	81	
Sample size	124	

Source: Field survey (2019)

### Potential yield

Potential yield is also calculated using the predicted TE in Table 3. It is estimated using the following formula:

$$\text{Potential yield} = 100/\text{TE} * \text{actual yield} \quad (7)$$

The estimated potential yield average of garlic farms in the area is 4.15 mt/ha. The most efficient farmer (96 percent TE) has a potential garlic yield of 4.18 mt/ha. He applies the recommended practices for garlic and so is expected to have a better yield than other farmers. Some of these practices include a higher seeding rate, mulching, and irrigation. These could be adopted by other farmers in the sample to further enhance their yield.

The results also suggest that by eliminating farm inefficiencies in the study area, average farm productivity can be increased from 3.40 mt/ha to 4.15 mt/ha. However, this potential yield is still relatively low compared to the 6.50 mt/ha yield in the province of Occidental Mindoro.

### Competitiveness Analysis

To analyze the competitiveness (in terms of import substitution) of locally produced garlic, the IPP and the DRC were estimated.

#### Import competitiveness analysis

Table 4 presents the calculated IPP of fresh garlic from China. This country has been selected as the test case since it is one of the world's major exporting countries of garlic ([FAO 2019](#)). China has an average garlic yield of 27 mt/ha ([Dy 2018](#)) and in 2016, it exported 1.53 million tons of garlic ([FAO 2019](#)). Moreover, 89 percent of the Philippines' imported garlic came from China.

Both imported (Chinese) and native (Philippine) garlic are widely used as seasonings and condiments in the Philippines. Results of the interview with producers and traders highlight that some buyers prefer native garlic because it has a stronger taste, flavor, and aroma; one bulb of this variety is equivalent to three bulbs of imported garlic. But in terms of bigger bulb or clove size, other buyers prefer Chinese garlic. However, as of this writing, there are very limited studies that

**Table 4. Cost of importing 5,000 kg of fresh garlic from China, 2018**

Particulars	Garlic	
	USD	PHP (USD 1.00 = 52.66)
<b>FOB<sup>a</sup> Price</b>	<b>2,250.00</b>	<b>118,485.00</b>
Insurance <sup>b</sup>	337.50	17,772.75
Freight cost <sup>c</sup>	87.50	4,607.75
Cost, Insurance, and Freight (CIF) <sup>a</sup> price (Philippine port)	2,675.00	140,865.50
<b>Duties and Taxes</b>		
Customs duty <sup>d</sup>	—	4,225.97
Customs documentary stamp <sup>e</sup>	—	250.00
Import processing fee <sup>f</sup>	—	265.00
BIR stamp	—	15.00
VAT <sup>g</sup>	—	17,474.58
<b>Sub-Total</b>	—	<b>22,230.54</b>
<b>Transport cost<sup>h</sup></b>	—	<b>2,468.44</b>
<b>Total cost per 5,000 kg</b>	—	<b>165,564.48</b>
<b>Total cost per kg</b>	—	<b>33.11</b>

Notes:

<sup>a</sup>FOB and CIF assumptions were taken from alibaba.com and shipping-container-housing.com. <sup>b</sup>Insurance: 15 percent of the good's value. <sup>c</sup>Freight cost: 5,000 kg (minimum import volume)/24,000 kg (cargo's capacity) x USD 420/ container. <sup>d</sup>Customs duty = CIF Price (Philippine Port, in PHP) x rate of duty; rate of Duty for garlic= 3 percent. <sup>e</sup>Customs documentary stamp: PHP 265 (fixed fee). <sup>f</sup>Import processing fee for goods worth PHP 250,000 and below PHP 250. <sup>g</sup>VAT =12 percent of Total Landed Cost (TLC); TLC = CIF price + Customs Duty +Customs Documentary stamp (CDS) + import processing fee (IPF) + BIR stamp. <sup>h</sup>Transport cost: (10% of FOB price x 5,000 kg x exchange rate)/maximum import volume. Maximum import volume: 24,000 kg.

analyze and/or compare the physical and chemical properties of Chinese and Philippine garlic. Hence, the analysis performed in this study is only limited to the price competitiveness of Philippine native garlic.

As shown in Table 4, the border price in 2018 of five tons of garlic in China was USD 2,250.00 (PHP 118,485.00). Freight and insurance cost that year was estimated to be PHP 22,380.50, while duties and taxes amounted to PHP 22,230.54. Since imported fresh garlic costs only PHP 33.11/kg while the estimated total cost of local garlic is PHP 52.27/kg (farm gate price of PHP 38.72/kg plus marketing cost of PHP 13.55/kg), it can be concluded that in 2018, it was cheaper for the country to purchase garlic from China. This finding also suggests that the price of imported garlic is still cheaper by PHP 19.16/kg when sold to wholesale market in Ilocos Norte than the domestic garlic. Furthermore, the ratio of IPP

**Table 5. Import competitiveness of Ilocos Norte's garlic, 2018**

Item	Value (PHP/kg)
Import parity price (IPP) (A)	33.11
Domestic wholesale price (DWP) (B) <sup>a</sup>	52.27
A/B	0.63

Note: Marketing costs (e.g., transportation and transactions cost)

to the domestic wholesale price (DWP) is 0.63 (Table 5), implying that locally produced garlic cannot compete with the less expensive imported garlic from China. Therefore, given the existing market structure and government interventions, locally produced garlic is less price-competitive than its imported counterparts.

**Table 6. Domestic resource cost of garlic production, Pasuquin, Ilocos Norte, 2018**

Item	Value
CIF price <sup>a</sup> (USD/mt)	628.75
Garlic yield <sup>b</sup> (t/ha)	3.40
Exchange rate <sup>c</sup> (PHP/USD)	52.66
Domestic cost <sup>d</sup> (PHP/ha)	109,500.00
Foreign cost <sup>e</sup> (PHP/ha)	22,150.00
Total cost (PHP/ha)	131,650
<b>Domestic resource cost (PHP/USD)</b>	<b>63.77</b>
<b>Resource cost ratio</b>	<b>1.21</b>
<b>Break-even yield (mt/ha)</b>	<b>3.98</b>

<sup>a</sup>CIF price of garlic from China. <sup>b</sup>Average garlic yield in Pasuquin, Ilocos Norte. <sup>c</sup>Source: BSP (2019). <sup>d</sup>Cost of labor, planting materials, and rice straw. <sup>e</sup>Cost of fertilizer, chemicals, and fuel and oil.

structure, locally produced garlic cannot compete yet with the imported garlic from China. China's competitive advantage can be attributed to a higher level of productivity. The country's garlic yield is seven times the yield of the Philippines. Hence, it is not surprising that China dominates the local and global garlic market, for it can offer large volumes of exports at relatively lower prices.

### Sensitivity Analysis

Based on the estimated break-even yield in Table 6, it can be concluded that in terms of import substitution, the Philippines can compete with imported Chinese garlic if yield of local farmers increases beyond 3.98 mt/ha. The sensitivity of the garlic industry in Pasuquin to various risks and opportunities was analyzed using several scenarios.

### DRC analysis

As shown in Table 6, the DRCR is 1.21, implying that the Philippines has no competitive advantage in domestic garlic production that will substitute for imports. This also means that, given the country's existing interventions and market

### Increase in yield

Table 7 shows the opportunities of boosting the productivity of local garlic producers. The import price competitiveness analysis revealed the country can gain price competitiveness once the yield has been increased by at least 60 percent. Increasing the productivity from 3.40 mt/ha to

**Table 7. Sensitivity analysis in garlic production, Philippines, 2018**

Items	Base	Scenarios				
		Increase in yield			15% sales reduction	30% farmgate price reduction
		20%	30%	60%		
Garlic yield (t/ha)	3.40	4.08	4.42	5.44	3.40	3.40
Farmgate price (PHP/kg)	70.00	70.00	70.00	70.00	70.00	49.00
Gross sales (PHP/kg)	238.00	285.60	309.40	380.80	202.30	166.60
Cost (PHP/kg)	38.72	32.27	29.79	24.20	45.55	38.72
Net return ('000 PHP/ha)	106.35	153.95	177.75	249.15	70.65	34.95
Net return to cost ratio	0.81	1.17	1.35	1.89	0.54	0.27
Break-even price (PHP/kg)	38.72	32.27	29.79	24.20	45.55	38.72
Break-even quantity (kg/ha)	1,880.71	1,880.71	1,880.71	1,880.71	1,880.71	2,686.73
<b>IPP/DWP</b>	<b>0.63</b>	<b>0.76</b>	<b>0.82</b>	<b>1.01</b>	<b>0.54</b>	<b>0.63</b>
<b>RCR</b>	<b>1.87</b>	<b>0.97<sup>CA</sup></b>	<b>0.88<sup>CA</sup></b>	<b>0.69<sup>CA</sup></b>	<b>1.49</b>	<b>1.21</b>

Notes:

IPP = import parity price

DWP = domestic wholesale price

CA = Competitive advantage

5.44 mt/ha means that the cost of production and the DWP will be reduced to PHP 24.20/kg and PHP 32.67/kg, respectively. This computes for a ratio of the IPP to the DWP equivalent to 1.01, showing that locally produced garlic can already compete with those imported from China since the domestic price is now lower than the IPP.

Increasing local garlic yield also has implications to the DRC. Based on Table 7, the Philippines can have a competitive advantage (DRCR = 0.97) in garlic production if yield increases from 3.4 mt/ha to 4.08 mt/ha (20% yield increase). This is consistent with the result in Table 6, showing that the Philippines can have a competitive advantage in garlic production if local garlic farmers' yield increases beyond 3.98 mt/ha. For instance, a 30 percent increase in yield level generates a DRCR of 0.88, implying that the Philippines has a competitive advantage in garlic production that will substitute for import. This also means that the competitiveness of garlic can be further improved if local garlic yield will be increased from 3.4 mt/ha to 4.4 mt/ha. This is quite possible for the Philippines since the highest recorded yield in the country is 6.15 mt/ha.

### **Reduction in sales and price received (farmgate price)**

Results of the interview revealed that reduced volume of sales and/or lower price received are experienced by farmers if they offer poor quality products to market (e.g., traders and direct consumers). Poor quality garlic is often associated with improper post-harvest practices.

Table 7 also shows the effects of reduction in sales brought about by improper post-harvest practices. On the average, the sales and output price received are reduced by 15 percent and 30 percent, respectively. A 15 percent reduction in sales will reduce the net return-to-cost ratio from 0.81 to 0.54. The profit is still positive but based on the estimated DRCR = 1.49 and IPP/DWP = 0.54, the country's competitive disadvantage will be further aggravated when garlic sales are reduced to PHP 202.30. The same is true when there is a

price cut. When there is a 30 percent reduction in farmgate price, from PHP/kg 70 to PHP 49/kg, the net return-to-cost ratio will be as low as 0.27. Again, given the current market structure and government interventions in the Philippines, local garlic cannot compete with Chinese garlic, as shown by the DRCR of 1.21.

### **SUMMARY, CONCLUSION, AND RECOMMENDATIONS**

Garlic production in the Philippines is mainly concentrated in the Ilocos Region, particularly in Ilocos Norte. The province remains the top garlic producer in the country, contributing 4,522 mt or 62 percent of the total national garlic output in 2019. However, the Philippines remains dependent on imports for its domestic garlic needs. Sluggish growth and the poor productivity of garlic farms are the main constraints.

In Pasuquin, Ilocos Norte, the mean garlic yield is only 3.4 mt/ha, which is below the best performing province (i.e., Occidental Mindoro), with yield of 6.50 mt/ha. It is also a far cry from garlic exporting countries like China with a yield of 27 mt/ha. Based on the study, the productivity of garlic farms in Pasuquin, Ilocos Norte can still be improved by adopting management practices and techniques performed by the best farmer in the study area. The mean TE of garlic farmers (81%) implies that there is still room to improve garlic productivity by focusing effort on eliminating farm inefficiency.

Using the stochastic frontier model, the amounts of planting materials (seeds), fertilizer (kg of N), and herbicide significantly and positively influence garlic yield. Meanwhile, the factors affecting the TE include education, farm size, and distance from the FMR.

Both import competitiveness and DRC analyses proved that locally produced garlic cannot compete yet with its foreign counterpart from China. The DRCR showed that, given the existing market structure and government interventions,

the country has a competitive disadvantage in domestic garlic production. Based on the estimated break-even yield, the Philippines can still improve its relative position of competitiveness if the yield of local farmers increases by at least 20 percent beyond 3.98 mt/ha.

Sensitivity analysis reveals that risks in garlic production and marketing will aggravate the country's competitive disadvantage in garlic production. Despite having a positive profit, both scenarios of a 15 percent reduction in sales and a 30 percent output price cut indicate that the Philippines cannot compete with imported garlic from China. On the other hand, if the existing mean garlic yield in Pasuquin, Ilocos Norte is increased from 3.4 mt/ha to 3.98 mt/ha, a competitive advantage in garlic production can be achieved. This also implies that improvement in the country's level of competitiveness (competitive advantage over Chinese garlic in terms of import substitution) can be realized if measures to improve garlic yield will be implemented in the country.

The results show the need to re-visit the government's output and input policies and programs for increased production and competitiveness of garlic farming in Pasuquin, Ilocos Norte. Further, since productivity also equates to competitiveness, the study suggests that the government should invest in technologies that will increase productivity, such as adopting good quality seeds. Moreover, to further enhance their TE scores, farmers must be encouraged to join or organizations. Interventions that will provide farmers with better access to infrastructure facilities such as FMRs are also highly encouraged.

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