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Analyzing the Impact of Internal Supply Chain Activities in Agriculture on Export Performance of High Value Crops in the Philippines

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***Abstract*: This paper presents the analysis of the impact of internal supply chain activities in agriculture on export performance of high value crops in the Philippines.**

***Keywords*: internal supply chain, crop export performance, inventory management, post-harvest management, agricultural land use.**

1. Introduction

The importance of trade and services has increased in the world economy. The Agricultural Global Supply Chain has a high percentage of international trade (ILO, 2017). In agri food systems, it plays an important role in providing food sustainability to the consumers worldwide, and generates income and widens employment opportunities in agricultural and food industries worldwide. An estimated one-third of agri-food exports are traded within global supply chains. Since 1995, agri-food trade has doubled, and this is due to the impact of trade liberalization. However, the financial crisis during 2008 has made the agricultural trade performance stagnant (FAO, 2022). This caused the rising of food prices. National policy responses have been made at the time to combat this issue. Exporting countries discouraged exports to increase domestic food supplies and prevent rising food prices, while importing countries reduced or eliminated import tariffs (Shuquan, 2018).

COVID-19 pandemic during the 2020 has also hindered the performance of agricultural global trade, reducing the agricultural trade by 5 to 10 percent. Most non-food items and higher value agri-food products were more severely impacted by the pandemic. Disruptions in supply chain and logistics delay has also been a problem due to the implemented health protocols. Despite that, the agricultural trade was considered as "resilient" in facing the consequences of the pandemic (Arita et al., 2022). The Food and Agriculture Organization has implemented a COVID-19 Response and Recovery Programme, which aims to increase resilience and combat the disruptions brought by COVID-19 in the food systems (FAO, 2020).

The Philippines' agricultural export has played an important role in the country's agricultural sector and economy by providing more economic activities and earnings on foreign exchange (Empal, 2019). The Philippines' agricultural sector started growing adequately during the 1960s to 1970s due to the new technologies during the time. Agribusiness in the country also started in its major export crops and enjoyed a commodity boom worldwide. However, there was a decreased growth in the 1980s but recovered in the 2000s due to the price surge. In the 2010s, the growth experience was only 2% (Briones, 2021). As of today, the International Trade Administration (2024) stated that the Philippines' export performance of US agricultural products is the top largest in Southeast Asia and eighth largest in the global market. The Philippines, already an established and dependable trading partner, continues to give opportunities to exporters due to its increasing population and household income. The US, despite experiencing issues in its logistics and tariffs, remains as the largest single-country supplier of agricultural products to the Philippines. PSA (2024) reported that as of 2023, the commodity "edible fruits and nuts; peel of citrus fruit melons" has the largest share of exports, amounting to 30.4 percent share among the agricultural commodities, with the value of USD 1.96 Billion. The export revenue of the sector is also said to have declined by 14.3 percent in 2023. The study of Białowąs & Budzyńska (2022) revealed that in 2018, Philippines is one of the Asian countries with weak global value chain links, and that the share of foreign value added did not exceed 10% of gross exports.

Agricultural land use in the Philippines plays a crucial role in the food supply chain. Agricultural land use influences food crop supply by shaping national production structures, impacting export competitiveness, and potentially leading to import dependency for ensuring food security (Chivu et al., 2021). To address these issues, there is a need for agricultural development to enhance productivity and strengthen linkages across the supply chain, including farm production, services, and agro-processing (Salerno, 2014). Furthermore, the transformation of agricultural land for non-agricultural purposes, like housing and trade centers, impacts agricultural production and the supply chain in regions such as Namlea District in the Philippines (Umanailo et al., 2021).

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Supply chain practices significantly impact the export performance of crops, especially in postharvest management in the Philippines (Yusmiati et al., 2023). Post harvest management also plays a crucial role in the export performance of crops in the Philippines. Postharvest operations in the Philippines contribute to over 55% of agricultural value, but high losses and new technology challenges hinder their delivery. Recommendations include training extension workers and establishing zonal centers for research and extension. (Del Carmen & Bautista, 2016). The Philippines' agricultural sector, which accounts for 8.6% of GDP, often leads to significant post-harvest losses, with up to 50% of losses occurring from harvesting, grading, packaging, and transportation from the field to storage and distribution (Mopera, 2016). Pastolero & Sassi (2022) found that around one-fifth of the quantities edible of edible bananas, rice, and corn are lost during the supply chain process. The contributing factors to these losses are during the drying and harvesting stage of these crops.

Farmers and fishermen in the Philippines were not able to sustain the supply of food. Because of the opening of the country to the global market, farmers shifted to producing high yielding crops therefore decreasing the availability of foods in the local market (Ebo, 2017). This has made the Philippines become import dependent on other crops, especially in rice. Without the additional stocks from imports, the Philippines will be insufficient in rice (Cardona & Garcia, 2016). Low competitiveness, high production costs, and underinvestment's are the reason for the country's rice import dependency, and was worsened by the liberalization of rice trade. This prompted the DA to maintain forty-five days of an emergency stockpile (Davidson, 2016).

This research aims to identify if internal supply chain activities such as Agricultural Land Use, Inventory Management and Post Harvest Management, have a significant impact on the export performance of high value crops in the Philippines.

This study will focus on the internal supply chain activities of high value crops in the Philippines, and its impact on export performance of these crops. The selected high value crops Banana, Mango, Pineapple, Papaya, and Watermelon. These crops were selected as they belong to the category of "edible fruits and nuts", the leading export commodity in Philippine agriculture as of 2023. The internal supply chain activities observed are Agricultural Land Use measured by number of area harvested (in hectares), Post-harvest Management measured by Post-harvest Losses, and Inventory Management measured by number of production during the domestic period. The years observed will be from 2010-2022, since it is the years with available data from Philippine Statistics Authority (PSA) Database.

The significance of this research is to help in assessing the internal supply chain gaps of the agriculture sector in the country. The discoveries can educate arrangement mediations by the government to streamline directions, present cutting-edge advances, and bridge framework holes, which could offer assistance to boost yields, decrease post-harvest misfortunes, and improve traceability and nourishment security for trades. This ponder will give a system to update supply chains to empower Philippine agriculture to realize its full potential as an engine of financial development through higher value-added exports.

2. Review of Related Literature

A. *Internal Supply Chain Activities on Agri-food Exports*

Agriculture is linked to the Global Value Chain generally as an upstream provider of food, fiber and fuel, with the food sector more of a downstream user of agricultural materials. Agriculture can benefit from GVCs through exporting primary products and downstream processing (OECD, 2021). Utilizing supply chain in export activities improves its efficiency and makes it easier to the sender and receiver. (Kolesnikov, 2020). The Food Supply Chain has become increasingly important due to globalization and the participation of most countries in the export market. It has the power to influence the flow of market and non market information. Tighter relationship between buyers and producers results to improved transparency, increased knowledge transfer, and reduced cost access to inputs, services, and technology for farmers (Otter, 2014)

ILO (2021) explained the different stages in the Agricultural Global Supply Chain. It starts with land preparation and seed planting, followed by crop husbandry and harvesting. Afterwards is the transporting of products for processing. The last steps before consumption include distribution and marketing. The supply chain for agricultural export is more complex than the other sectors due to supply and market fragmentation, environmental changes, seasonal fluctuations, and diversity (Kolesnikov, 2020). Agri-food chain is "buyer-driven", which is found at the downstream market. In the case of international trade, the importer has more power, in which he can impose preferences and set minimum requirements for the commercialized product to comply. Downstream players can be commercial companies, agro-industrial companies, and wholesalers (Hou et al., 2015).

In internal supply chain activities in agriculture, resource utilization is important. According to Olukunle (2013), increasing access to resources such as land and technology (improved inputs) will improve agricultural production, processing and trade. For this to be achieved, he suggested that private sectors must invest in development of agricultural equipment for the improvement of processing, storage, and other farm operations. Land and water resources are used to produce food. Due to the increasing globalization, the geographical locations of food production and consumption are becoming increasingly disconnected, which increases reliance on external resources and their trade (Fader et al., 2013)

Welteji (2018) studied the performance of Ethiopian agriculture and found that it has been suffering from various external and internal problems. It has been stagnant due to poor performance as a result of factors such as low resource utilization; low-tech farming techniques (e.g. wooden plough by oxen and sickles); over-reliance on fertilizers and underutilized techniques for soil and water conservation; inappropriate agrarian policy; inappropriate land tenure policy;

ecological degradation of potential arable lands; and increases in the unemployment rate due to increases in the population. Erokhin et al., (2014) discovered in his study that Chinese agriculture is experiencing scantiness of natural resources, which may stipulate aggressive trade policies and domestic protectionism in the market. Briones (2013), meanwhile, analyzed the performance of the mango industry in the Philippines. The following observations are made in his study: vertical linkage is a solution in elevating mango quality to export grade; economies of scale has an impact on marketing and processing stages of mango export; enterprise size is vital in the prominence of horizontal market structure in the export sector; stakeholders must focus on availability of mangoes for export to increase its export performance.

B. Agriculture Land Use

Supply chain practices play a crucial role in enhancing the export performance of crops and optimizing agriculture land use, by implementing efficient supply chain management strategies, such as the integration of IoT ecosystems for mobile cold storage (Chakrabarty & Nandi, 2022), and setting minimum price guarantees for farmers (Kouvelis et al., 2020).

Agricultural land use significantly impacts food crop supply by influencing the availability of land for cultivation and the efficiency of production. Land-use changes, such as conversion of forest and pasture lands for biofuel feedstock production (Zhuang et al., 2022), can directly affect food crop supply. Additionally, the adoption of genetically engineered (GE) seeds has shown to increase crop yields, potentially expanding the range of lands that can be farmed profitably and increasing overall supply effects (Steinbuks & Timilsina, 2014). Furthermore, agricultural land use changes have been linked to food production trends, with studies showing that land fragmentation, population increase, and urbanization can lead to decreased agricultural land and food production, ultimately affecting food security in regions like Keumbu in Kisii County (Oyinloye, 2015). Agricultural land use changes, like converting paddy fields to rubber plantations, decrease food crop production, impacting local food supply and smallholder farmers' food security and income (Sakayarote & Shrestha, 2019). Agricultural land availability affects food crop supply by determining the potential for expansion or intensification of agricultural production, influencing global food security and land use emissions (Mandryk et al., 2015). Efficiency in agricultural land use directly affects food crop supply by influencing crop yield, production per person, and overall agricultural productivity, crucial for food security and sustainability (Dorohan-Pysarenko & Berkalo, 2022).

Changes in agricultural land use in Turkey, influenced by policies and modernization, have impacted food crop production levels positively, with notable increases in wheat, barley, corn, cotton, tea, and sunflower (Ichiminami et al., 2016).The Romanian agricultural sector's transformations have shifted land use paradigms, affecting agro-food products' competitiveness on the world market. The Balassa index assesses agro-food competitiveness for barley, maize, triticale, wheat, poultry meat, oilseeds, and tobacco. Barley and wheat cultivation areas decreased, despite high export performance (Popescu et al., 2017). Initiatives like web-enabled GIS platforms are being developed to improve agricultural land use management, aiding in decision-making for local leaders and benefiting farmers and communities (Acedo, 2020). Land-use efficiency impacts food crop supply by influencing the amount of food produced per unit of cropland. Improving efficiency can help meet growing food demands sustainably (Duro et al., 2020). Additionally, the promotion of intensive farming through certifications coexists with diversified livelihood activities, showcasing the compatibility of certification-supported farming with income-generating opportunities (Makita, 2016). Agricultural land use in the Philippines, particularly in Metro Manila, has undergone significant changes due to urbanization pressures and socioeconomic factors (Alexander et al., 2019). Land use changes in agricultural systems impact food crop supply by influencing crop yields, economic profit, and environmental conditions, as shown in the AgroDEVS model simulations. (Pessah et al., 2022).

C. Postharvest Management

Effective supply chain practices play a crucial role in the export performance of crops, especially concerning postharvest management. Research emphasizes the significance of investing in market infrastructures, such as storage facilities and cold chain logistics, to reduce postharvest losses and enhance the quality of horticultural produce for export (Roy, 2015). Postharvest losses can cause mechanical damage, sap burn, spongy tissue, weight loss, fruit softening, decay, chilling injury, and diseases. Various postharvest technologies are being applied to reduce quality losses and improve marketability. This review aims to provide comprehensive information on the physicochemical changes of mango fruits and identify appropriate technologies at each critical step in the supply chain (Le et al., 2022). Additionally, structured postharvest handling in export-oriented chains, with centralized pack-houses and cool storage, showcases the importance of organized supply chain practices in maintaining product quality for international trade (Underhill, 2013).

Cold chain management is essential to reduce postharvest losses, which leads to higher exports. Exporters must handle cold chains to deal with the perishability of foods (Titlo & Sopadang, 2019). Postharvest cold chain is a key for fruit quality to meet export standards (Conradie et al., 2022). The importance of the cold chain can be seen in China's agricultural performance. According to Zhao et al., (2018), food waste and losses increased due to incomplete cold chain activities.

Postharvest improvements are significant in meeting market demands, such as consistent quality and size of fruits (Fronda, 2022). Additionally, the adoption of Good Agricultural Practices (GAP) is essential for export crops like bananas and mangoes, with GAP certification enhancing market access and competitiveness (Maunahan et al., 2015). Implementing agribusiness venture arrangements (AVAs) for export crops such as banana and pineapple can also improve farm income and productivity, contributing to the sustainability of the agrarian sector (Briones, 2014).

Post-harvest losses and food saving measures in developing economies face challenges such as limited access to farm inputs, poor infrastructure, and lack of technical and market information. These factors limit farmers' ability to reduce losses and engage in expanding domestic and international markets (Gunasekera & Smith, 2017). Value chain studies emphasize the importance of primary production and marketing systems for export-oriented crops, highlighting the need for efficient postharvest practices to capitalize on value chain opportunities (Moreno et al., 2020). Sustainable supply chain management practices, such as collaboration and strategic orientation, play a crucial role in enhancing economic, social, and environmental performance in the food industry (Skalkos, 2022). Regional food systems can benefit from logistics best practices derived from conventional supply chains to improve efficiency and effectiveness, ultimately enhancing the viability of the regional food supply chains.The COVID-19 pandemic has underscored the importance of agility in supply chains, emphasizing the need for adaptable frameworks like the Supply Chain Agility Framework to navigate challenges in both stable and turbulent business environments, such as those faced by fresh produce export supply chains in developing countries like Ghana (Mittal & Craven, 2018).

D. *Inventory Management*

Inventory is defined as "any stock that a firm keeps to meet its future requirement. Inventory must be kept and handled in order to be used when the time that it is actually needed already arrives (Negassa et al., 2014). Inventory management deals with fixed and current asset management. In terms of agriculture, it also entails the management of agricultural inputs and outputs (Mwangi, 2013). Inventory control in the food supply chain is essential for the ease of tracking usage (Dani, 2015). Cristhian et al. (2018) stated inventory management of agricultural products as a topic of increasing interest due to the restrictions brought by the product's perishability. Nowadays, the variety of fresh food products has increased. An example would be the corn products. In the past, there were only two types of corn: commodity and high value specialty. Today, various types of corn exist in the market. This has made inventory management decisions more complex (Corlu et al., 2019).

Managing inventory begins with a plan, which involves recognizing demand patterns, determining what value-added is required for each product, and identifying the inventory categories of each product (Poi, 2018). The study of Mwangi (2013) highlighted the importance of inventory on the operations of NGOs in the agricultural sector, as they may hold inventories as raw materials for further processing, work in progress, or finished goods. He also implied that NGOs must embrace inventory management techniques, such as marginal analysis, ReOrder Levels (ROL), and Economic Order Quantity (EOQ) computation. These techniques are helpful in knowing when to order and measuring the optimal stock levels. Imbachi et al. (2018) also suggested considering the optimal number of orders and its time in order to avoid costs brought by overstocking or understocking, and that the product's revision cycle must be higher than its deterioration cycle to avoid product losses. Poi (2018) implied that holding too much inventory incurs unnecessary costs. Imbachi et al., (2018) suggested that the production rate must be higher than the demand for the inventories to readily be able to meet the number of deliveries, but the possibility of product deterioration must also be considered and addressed.

Inventory holding of finished goods have two strategies: make-to-stock (MTS) and make-to-order (MTO). MTS refers to the decision in producing and stocking finished goods in order to be used for planning and forecasting. MTO must be produced at the arrival of the customer order (Anand et al., 2017). Shi et al. (2015) discovered the inventory management techniques used by coffee farmers in Kenya. Farmers increased their profitability by holding back inventories during the low price and selling it when the price increased. He also implied that inventory should not just be seen as a liability but an instrument for strategy to deal with price uncertainty if one knows how to hold and sell. This caused the inability of some small-scale farmers to take advantage of price increase due to not holding inventory, which led them to selling their products regardless of its price. Availability of inventory finance must also be increased, to enable exporters to stockpile, which provides them more regular supply. This results in an increased performance of delivery of goods and reduces uncertainty of contract performance of importers (Negassa et al., 2014).

One of SCM practices recognized is value stream mapping, which consists of three types: Necessary Non-Value Added (NNVA), Non-Value Added (NVA) and Value Added (VA). Inventorying is one of the NVA activities, and this period must be reduced to cut down cost and to improve swift responsiveness to importers. This practice is said to increase the export performance of parboiled rice in Thailand (Tansuchat et al., 2016). During the Value Added processing, raw materials inventory is reduced while finished products increase (Cristhian et al., 2018).

Food stock levels are also helpful in disaster readiness. A large part of it is held by private companies such as wholesalers, retailers, and food producers. Food stock levels are a vulnerability indicator for a region (Hansen et al., 2019). It is also an important tool for food security. However, it can be costly if used for redistribution purposes and price support. Trade can be an alternative to provide cheap food in order to enhance food access. Food security can be achieved effectively by creating a policy regarding trade and stock management (Dev & Zhong, 2015). Angsrisuraporn (2024) found in his study that some countries have low rice export levels despite its high productivity due to the high domestic consumption. To deal with this, the countries must store some of their rice in a silos awaiting export.

E. *Hypothesis*

H1: Increasing Agricultural Land Usage boosts exports of high value crops in the Philippines

H2: Increased post-harvest loss decreases exports of high value crops in the Philippines

H3: Proper inventory management has a direct relationship on export performance of high value crops in the Philippines

F. Synthesis

Based on the studies above, Agricultural Land Use, Post-harvest Management, and Inventory Management must have a positive relationship with the Export Performance of 5 high value crops in the Philippines.

The availability of land and the efficiency of its usage leads to higher crop yield, which also increases the number of exports of crops.

The importance of proper post-harvest handling is also mentioned in the related studies gathered. Cold chain management is essential in post-harvest to maintain product quality, especially for products to be exported.

Effective inventory management must also be practiced to increase export performace. Evidences in the studies above showed that such as knowing when to hold and sell increases farm profitability. However, due to the perishability of the products, post-harvest handling must be done at the same time. In terms of exports, a demand forecasting must be done to identify if a product must be sold domestically or internationally. Products meant to be exported must be stored on silos awaiting export.

G. Theoretical Framework

Supply chain resilience defines the ability of a supply chain to recover from disruptions and still perform (Huo et al., 2023). Towards this end, it is crucial in understanding how internal supply chain activities can impact the stability and success of high-value crop exports in the Philippines. This framework has been developed through a multi-phase methodology and integrates empirical data from global manufacturing supply chains in order to measure their resilience levels and identify key characteristics that contribute to robustness.

H. Simulacrum

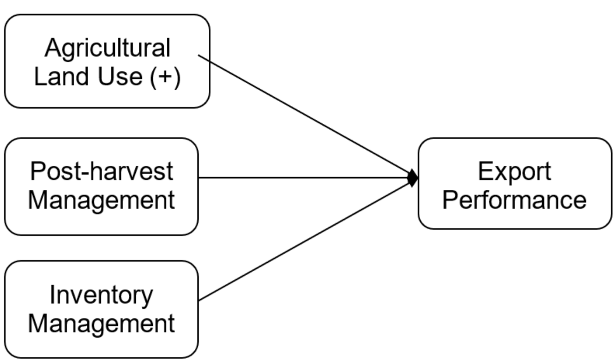

Fig. 1.

The figure 1 represents the relationships between the variables used in this study. The agriculture food export performance of food crops serves as the dependent variable and the main focus of this study. The independent variables used are the Internal Supply Chain metrics in Agriculture such as Agriculture Land use, Postharvest Management, and Inventory Management. Efficient Agricultural Land Use and proper Inventory Management is shown to have a positive impact on the export performance of high value crops, while Postharvest Management is negative since it is measured by the amount of postharvest losses of the high value crops.

3. Methodology

A. Research Design

The researchers employed quantitative research to analyze the numerical data used for this study, collected on Philippine Statistics Authority (PSA) Database, to analyze the variables in this study and identify the relationship of the independent variables to the dependent variable. The years observed for each variable are 2010-2022, as it is the years with publicly available data. The variables for this study will be observed annually.

B. Method

$$EP = \beta 0 + \beta 1 ALU_{\text{BMPPW}} + \beta 2 IM_{\text{BMPPW}} - \beta 3 PHM_{\text{BMPPW}} + \epsilon$$

Whereas:

- EP = measurement of export performance of agrifood crops using total exports of crops
- ALU = Agriculture Land Use, measured by amount of area harvested for a specific crop
- IM = Inventory Management Performance, measured by number of domestic production of crops.
- PHM = Post Harvest Management, measured by post harvest losses
- B = Banana
- M = Mango
- P = Pineapple
- P = Papaya
- W = Watermelon

Panel Data Analysis was conducted using the Gretl Software. Cross-Sectional Descriptive Statistics was used to analyze the performance of each crop, then Panel Descriptive Statistics was used for the observation of the overall 5 high value crops per variable. The researchers then utilized the Random Effects Model since the p-value of Breusch Pagan LM test and Hausman Test is less than the alpha of 0.05. Afterwards, the researchers checked if the data is normally distributed by checking the histogram of the data. Since the shape of the histogram depicts that the data for this study is normally distributed, the researchers analyzed the significance of the data using Generalized Least Squares (GLS) by checking its p-value, which resulted in less than 0.05, therefore, prompting the researchers to accept the alternative hypothesis that the variables are significant. White's test was also conducted to identify the presence of heteroskedasticity on the data. Lastly, the presence of specification errors was investigated using Ramsey's RESET.

4. Results and Discussion

A. Cross Sectional Descriptive Statistics

The table 1 shows that Banana has the largest mean in all variables, which indicates that Banana has the largest number of exports, area used in harvesting, postharvest losses, and number of crops produced during the domestic period in the year 2010-2022. The variables for Banana has low standard deviation, with EP of 872, 360, ALU of 3,718.8, 53,840, and IM of 177,990. This indicates that the data for Banana has low variability. Among the variables of Banana, the number of production is the highest while the post-harvest losses is the lowest.

Table 1

Variables	Mean	Maximum	Minimum	Std. Dev
EP (Banana)	4,403,500	4,403,500	1,590,100	872,360
ALU (Banana)	447,640	454,260	442,750	3718.8
PHM (Banana)	379,350	450,680	285,250	53,840
IM (Banana)	9,065,800	9,358,800	8,646,400	177,990
EP (Mango)	14,723	21,151	7,886	4,401
ALU (Mango)	187,150	189,440	184,200	1,440.4
PHM (Mango)	46104	53385	41886	3663
IM (Mango)	783,120	902,740	711,660	62385
EP (Pineapple)	458750	631,490	143,910	143,910
ALU (Pineapple)	63525	67722	58450	3559.4
PHM (Pineapple)	127,560	140,340	118,130	8547.0
IM (Pineapple)	2,584,000	2,914,400	2,169,200	223,340
EP (Papaya)	4189.6	8459	1391	2245.3
ALU (Papaya)	8023.7	8750.8	7554.3	411.12
PHM (Papaya)	9688.5	10249	9042.9	322.45
IM (Papaya)	165,660	172,650	157,910	4385.2
EP (Watermelon)	322.36	1602.0	0.00000	536.04
ALU (Watermelon)	7427.1	8663.5	6101.8	885.99
PHM (Watermelon)	7967.8	9030.8	6051.5	1053
IM (Watermelon)	133,120	150,520	101,520	17114

Mango has an average number of exports of 14,723 commodities, which makes it the third among the 5 high value crops that has the highest average exports during 2010-2022. It has an average land usage of 187,150 hectares, which indicates that it is not using its land as efficiently, since the land usage is higher than the number of exports. The postharvest loss for this crop has an average of 46,104, while the number of crops produced during the domestic period is 783,120. The standard deviation of variables for this crop is relatively low, which also indicates that the variability of the data for Mango is low.

Pineapple has the second highest amount of exports among the crops observed, with an average of 458,750. The land usage for harvesting this crop has an average of 63,525 hectares. The average amount of loss during the post-harvest stage is 127,560 commodities, and the number of crops produced is at an average of 2,584,000 commodities. Land usage and postharvest losses being lower than the number of exports indicates that the resources for this crop is being properly utilized. The standard deviation of the variables are also low, which means that the data are not as spread out.

Papaya is the fourth highest among the 5 crops in terms of exports, with an average of 4,190 commodities. The average land use for Papaya reached an average of 8,023.7 hectares. The post-harvest loss has an average amount of 9,689 commodities, while the number of crops produced has an average of 165,660 commodities. The land use and postharvest loss is higher than the number of exports, which indicates that the resources are not being utilized efficiently in boosting export performance. The postharvest loss is also higher than the land usage, which could mean that there is a need for improvement in post-harvest handling for Papaya. The standard deviation for the variables are also low, indicating that there is low variation in data.

Watermelon is the lowest among the high value crops observed. The average export number is 323 commodities, land usage of 7427.1 hectares, post-harvest loss of 7968 commodities, and 133,120 crops produced at an average. The land use and post-harvest loss is also higher than the average number of exports, which implies that resources are also not being utilized for exports. There is low variability in the data since the standard deviation is low.

Since the number of production for all the crops investigated are high enough, it could hint that the resources are being used efficiently for domestic consumption but the export strategies need improvement.

B. *Panel Descriptive Statistics*

Table 2

Variables	Mean	Maximum	Minimum	Std. Dev
EP	644,270	4,403,500	0.00000	1,138,700
ALU	147,270	454,260	6101.8	167,180
PHM	114,130	450,680	6051.5	142,580
IM	2,546,500	9,358,800	101,520	3,408,200

The Philippines generated an average of 644,270 exports of the 5 high value crops throughout the years 2010-2022. The maximum exports are 4,403,500 and the minimum exports are 6,101.8

The number of area in hectares used for harvesting the crops averaged at 147,270 hectares, the highest being 454,260 hectares and the lowest being 6101.8 hectares.

The number of postharvest losses within the time frame observed reached an average of 114,130. The highest amount of loss in the postharvest stage is 450,680 commodities while the least number of losses is 101,250 commodities.

The average number of crops produced in the years 2010-2022 is 2,546,500. The highest number of production is 9,358,800 and the lowest is 101,520.

C. *Random Effects Model*

Table 3

	Coefficient	Std. Error	z	p-value	
const	−201889	61845.6	−3.264	0.0011	***
d_d_ALU_1	−66.2221	19.4526	−3.404	0.0007	***
PHM_1	20.5663	2.00184	10.27	<0.0001	***
IM_1	−0.824553	0.0805760	−10.23	<0.0001	***

Table 4

Mean dependent var	−17776.48	S.D. dependent var	590862.2
Sum squared resid	4.99e+12	S.E. of regression	325954.2
Log-likelihood	−704.1256	Akaike criterion	1416.251
Schwarz criterion	1423.899	Hannan-Quinn	1419.164
rho	−0.133697	Durbin-Watson	2.121799

Table 5

Random effects	
Breusch-Pagan Test	0.00847312
Hausman Test	5.80389e-08

Panel Data Regression will be utilized to observe the data in the study from multiple cross sections over time. Random Effects Model is used since the p-value for Hausman and Breusch-Pagan is less than 0.05. All the variables are also lagged for 1 year to fix the autocorrelation errors.

The dependent variable used in the study was the export performance of each of the 5 high value crops while the 3 independent variables are the internal supply chain performance for each crop, such as Agricultural Land Use, Post-harvest Management, and Inventory Management.

All the explanatory variables have a significant relationship between the export performance of the 5 high value crops since its p-values are less than 0.05, with Post-harvest Management and Inventory Management having p-value of 0.0001 and 0.0007 for Agricultural Land Use.

The Export Performance has a negative coefficient of -201889. Since the Post-harvest Management, proxied as number of Post-harvest Losses of commodities, has positive coefficient, this indicates that Post-harvest Management has a negative relationship with the Export Performance of high value crops. Post-harvest Management has a coefficient of 20.5663. Therefore, the number of exports will decrease as the Post-harvest Losses increase by 20.5663 commodities. Roy (2015) implied that post-harvest handling plays a crucial role on export performance of horticultural crops and suggested that investments on market infrastructures such as cold chain logistics to reduce post harvest losses and maintain the quality of crops for exports. Gunasekera & Smith (2017) discovered that limited access to farm inputs, poor infrastructure, and lack of technical and market information, are the factors disrupting farmers in mitigating postharvest losses and increasing engagement to domestic and international markets. The study of Conradie et al. (2022) and Titlo & Sopadang (2019) puts emphasis on proper cold chain management during post-harvest stages to reduce postharvest losses brought by the product's perishability, and increase exports. Meanwhile, Briones (2014) suggested that Agribusiness Venture Arrangements must be implemented for export crops like Banana to improve farm income and productivity, which could lead to a sustainable agrarian sector.

The Inventory Management, with the proxy variable of Number of Production of commodities during the domestic period, has a negative coefficient, which is -0.824553. This states that the export performance will decrease as the number of production of the high value crops decreases by 0.824553 commodities. The evidence of this finding can be found in the study of Negassa et. al. (2014), emphasizing the increasing of inventory finance to enable exporters to stockpile to provide them more regular supply. This is said to have increased delivery performance and reduced the importers' uncertainty in contract performance. The study of Imbachi et al., (2018) suggested that production rate must be higher than demand for inventories to improve delivery performance. This is similar to the regression result of this study since the number of production is used as a proxy variable for inventory management performance.

Agricultural Land Use, measured by the number of areas harvested in hectares, has a coefficient of -66.2221. Since its coefficient is negative, Agricultural Land Use has a direct relationship with Export Performance of High Value Crops. The number of exports will decrease as the number of hectares of areas used in harvesting decrease by 66.2221 hectares. Olukunle (2013) concluded that improving inputs such as increasing access to land and technology will improve agricultural production, processing and trade. This conclusion is consistent with the regression result for agricultural land use and export performance.

White's test for heteroskedasticity was also used for this study, which tests the variance of errors in the OLS regression model, revealing a relationship between postharvest losses and production. The model fits moderately well, explaining 50% of the squared residuals variability, and p-value is less than 0.05, which indicates reject the null hypothesis of homoscedasticity. This suggests that the variance of the errors is indeed not constant, confirming the presence of heteroskedasticity in the model. Additionally, Ramsey's RESET Test was also utilized. The p-value for squares is 0.804, and the p-value for cubes is 0.26. The p-value for both squares cubes is 0.478. Since all the p-values for the RESET Test are greater than the alpha of 0.05, we must accept the null hypothesis that there is no specification error among the variables.

5. Conclusion and Recommendation

A. Conclusion

This research aims to analyze if internal supply chain activities such as agricultural land use, post-harvest management, and inventory management has a significant impact on the export performance of the high value crops in the Philippines. The crops observed are Banana, Mango, Pineapple, Papaya, and Watermelon. The years observed will be in 2010-2022 using the data collected from PSA Database.

The research uses a quantitative research design to investigate how internal supply chain activities affect high-value crops' export performance in the Philippines, with focus on five specific crops from the years 2010 to 2022. To clarify the interactions of agricultural land use in the export performance of the fresh produce and that of inventory management and post-harvest management of fresh produce, panel data analysis is employed. The research design and method employed in this study provide a robust foundation for understanding the complex relationships between internal supply chain activities and export performance in the agriculture sector.

Maximizing these supply chain activities will assist in nurturing the agriculture sector of the Philippines, increasing its competitiveness in exports and food security enhancement. The research indicates that there is a significant correlation between post-harvest management and inventory management in relation to export performance and agricultural land use. More post-harvest losses, decrease in agricultural land usage, and less effectiveness in management of inventory decreases exports earnings. These results emphasize the need for good post-harvest practices, sound inventory control and effective agricultural land use for better exports performance. The diagnostic tests provide evidence of the appropriateness of the Generalized Least Squares assumptions as well as the fit of the model employed. In this context, the present study explores the linkages existing between the factors that constitute the performance of the internal supply chain and the export performance of high-value crops.

The findings also present that Banana is the most efficient in utilizing its resources, leading to the highest number of exports among the crops observed, while the other crops investigated in this study needs improvement in terms of post-harvest handling and agricultural land usage. Other crops also generated lower exports despite higher production.

B. Policy Recommendation

The results recommend that post-harvest management, inventory management and agricultural land use should be prioritized in efforts to support the export performance of these crops and their share in the global market. To invest in cold chain facilities and practice cold chain management techniques for a more efficient post-harvest handling, decrease urbanization as it decreases land availability, which leads to lower crop yield. This could result not only in low exports but also increases the risk of food insecurity. Also store products meant to be exported in different silos, invest in education for farmers regarding farming techniques, proper demand planning to know what products to export and what to sell domestically, demand forecasting can also be helpful for effective inventory management, in order to know when to hold or sell inventory. Inventory must be sold when the price of the product is high and must be held when the price is low and apply the internal supply chain techniques from other crops that are not considered high value, especially the import dependent crops, to boost the overall export performance of the agricultural sector while allocating enough supplies for domestic consumption to maintain food security.

References

[1] Acedo, G. G. (2020, April 1). A Web-Enabled GIS Platform for Agricultural Land Use. IOP Conference Series: Materials Science and Engineering, 803(1), 012002.

[2] Acosta, I. C. G., Cano, L. a. F., Peña, O. D. L., Rivera, C. L., & Bravo, B. J. J. (2018). Design of an inventory management system in an agricultural supply chain considering the deterioration of the product: The case of small citrus producers in a developing country. IstražIvanja I Projektovanja Za Privredu, 16(4), 523–537.

[3] Alexander, P., Reddy, A., Brown, C., Henry, R. C., & Rounsevell, M. D. (2019, July). Transforming agricultural land use through marginal gains in the food system. Global Environmental Change, 57, 101932.

[4] Angsrisuraporn, P., Samakkarn, C., Lekawat, L., Singkhornart, S., & Thongsri, J. (2024). CFD—Assisted Expert System for N2-Controlled Atmosphere Process of Rice Storage Silos. Sustainability, 16(5), 2187.

[5] Annual Agricultural Export and Import, Philippine Statistics Authority, Republic of the Philippines. (2024). https://psa.gov.ph/statistics/agricultural-export-import/annual

[6] Arita, S., Grant, J., Sydow, S., & Beckman, J. (2022). Has global agricultural trade been resilient under coronavirus (COVID-19)? Findings from an econometric assessment of 2020. Food Policy, 107, 102204.

[7] Białowąs, T., & Budzyńska, A. (2022). The importance of global value chains in developing countries' agricultural trade development. Sustainability, 14(3), 1389.

[8] Briones, R. M. (2014). Compilation and Synthesis of Major Agricultural Value Chain Analysis in the Philippines. https://hdl.handle.net/10419/127002

[9] Briones, R, M. (2021). Philippine agriculture: Current state, challenges, and ways forward. Philippine Institute for Development Studies

[10] Cardona, K. P., & Garcia, D. R. (2016). Self-Sufficiency in Rice: Analysis of Production, Consumption, and Importation of the Rice-Producing Regions in the Philippines.

[11] Chakrabarty, A., & Nandi, S. (2022b). Sustainable Agricultural Supply Chains for Leveraging SDGS. The Management Accountant Journal, 57(10), 29.

[12] Chivu, L., Constantin, M., Privitera, D., & Andrei, J. V. (2021). Land Grabbing, Land Use, and Food Export Competitiveness: Bibliometric Study of a Paradigm Shift. Shifting Patterns of Agricultural Trade, 143–164.

[13] Conradie, C. A., Goedhals-Gerber, L. L., & van Dyk, F. E. (2022). Detecting temperature breaks in the initial stages of the citrus export cold chain: A case study. Journal of Transport and Supply Chain Management, 16, 818.

[14] Dani, S. (2015). Food supply chain management and logistics: From farm to fork. Kogan Page Publishers.

[15] Davidson, J. S. (2016). Why the Philippines Chooses to Import Rice. Critical Asian Studies, 48(1), 100–122.

[16] Del Carmen, D., & Bautista, O. (2016, June 15). Nature and Extent of Extension Delivery on Postharvest Handling of Horticultural Perishables in the Philippines. Asian Journal of Agriculture and Development, 13(1), 87–103.

[17] Dev, S. M., & Fang, Z. (2015). Trade and stock management to achieve national food security in India and China? China Agricultural Economic Review, 7(4), 641–654.

[18] Dorohan-Pysarenko, L., & Berkalo, M. (2022). Efficiency of Land Use in Agriculture: Theoretical Foundations. Market Infrastructure, 67.

[19] Duro, J. A., Lauk, C., Kastner, T., Erb, K. H., & Haberl, H. (2020, September). Global inequalities in food consumption, cropland demand and land-use efficiency: A decomposition analysis. Global Environmental Change, 64, 102124.

[20] Ebo, J. B. F. (2017). Sustaining Food Security in the Philippines: A Time Series Analysis. Asian Journal of Agriculture and Food Sciences (ISSN: 2321–1571), 5(06).

[21] Empal, A. (2019). Export Competitiveness of Selected Agricultural Products of the Philippines. Department of Agriculture Economics. https://acikbilim.yok.gov.tr/bitstream/handle/20.500.12812/126031/yokAcikBilim_10274654.pdf?sequence=-1&isAllowed=y

[22] Erokhin, V., Ivolga, A., & Heijman, W. (2014). Trade liberalization and state support of agriculture: effects for developing countries. Agricultural Economics/Zemědělská Ekonomika, 60(11).

[23] Fader, M., Gerten, D., Krause, M., Lucht, W., & Crämer, W. (2013). Spatial decoupling of agricultural production and consumption: quantifying dependences of countries on food imports due to domestic land and water constraints. Environmental Research Letters, 8(1), 014046.

[24] FAO (2022). The State of Agricultural Commodity Markets 2022. The geography of food and agricultural trade: Policy approaches for sustainable development. Rome, FAO.

[25] FAO (2020). FAO COVID-19 Response and Recovery Programme.

[26] Fronda, J. (2022) The Supply Chain of Vegetable Production in the Philippines: The Case of Nueva Ecija Farmers. Open Journal of Social Sciences, 10, 16-27.

[27] Gunasekera, D., Parsons, H., & Smith, M. (2017, November 13). Post-harvest loss reduction in Asia-Pacific developing economies. Journal of Agribusiness in Developing and Emerging Economies, 7(3), 303–317.

[28] Hansen, O. E., Friedrich, H., & Transchel, S. (2019). An inventory management approximation for estimating aggregated regional food stock levels. International Journal of Production Research, 58(19), 5769–5785.

[29] Hou, M. A., Grazia, C., & Malorgio, G. (2015). Food safety standards and international supply chain organization: A case study of the Moroccan fruit and vegetable exports. Food Control, 55, 190–199.

[30] Huo, B., Li, D., & Gu, M. (2023). The impact of supply chain resilience on customer satisfaction and financial performance: A combination of contingency and configuration approaches. *Journal of Management Science and Engineering*, *9*(1), 38–52.

[31] Ichiminami, F., Dinçsoy, E. E., & Dinçsoy, M. O. (2016). Spatial dimension of change in agricultural land use and impact on crop production in Turkey, Journal of the Faculty of Environmental Science and Technology, 21(1), 1–32.

[32] International Labour Organization. (2017). World employment and social outlook: Trends 2017 (p. 2017). Geneva: Ilo.

[33] Kolesnikov, A., Nasedkina, T., Zdorovets, Y., Chernykh, A., & Gruzdova, L. (2020). Agriculture Export Supply chain management in Belgorod region. International Journal of Supply Chain Management, 9(1), 702–706.

[34] Kouvelis, P., Li, J., & Dada, M. (2020). Agricultural Networks in Emerging Markets: Planting, Pricing and Processing Policies. SSRN Electronic Journal.
[35] Le, T. D., Viet Nguyen, T., Muoi, N. V., Toan, H. T., Lan, N. M., & Pham, T. N. (2022). Supply Chain Management of Mango (Mangifera indica L.) Fruit: A Review with a Focus on Product Quality During Postharvest.
[36] Lin, Y., Liang, B., & Zhu, X. (2018). The effect of inventory performance on product quality. International Journal of Quality & Reliability Management, 35(10), 2227–2247.
[37] Makita, R. (2016, April). Livelihood diversification with certification-supported farming: The case of land reform beneficiaries in the Philippines. Asia Pacific Viewpoint, 57(1), 44–59.
[38] Mandryk, M., Doelman, J., & Stehfest, E. (2015, November 1). Assessment of global land availability: land supply for agriculture. RePEc: Research Papers in Economics.
[39] Maunahan, M., Absulio, W., Esguerra, E., Sun, T., & Collins, R. (2015, June). A Value Chain Approach to Developing Export Markets For "Solo" Papaya Farmers in the Philippines. Acta Horticulturae, 1088, 277–282.
[40] Mittal, A., Krejci, C., & Craven, T. (2018, January 11). Logistics Best Practices for Regional Food Systems: A Review. Sustainability, 10(2), 168.
[41] Mopera, L, E. (2016). Food Loss in the Food Value Chain: The Philippine Agriculture Scenario. Journal of Developments in Sustainable Agriculture.
[42] Moreno, M. L., Kuwornu, J. K. M., & Szabo, S. (2020, April 6). Overview and Constraints of the Coconut Supply Chain in the Philippines. International Journal of Fruit Science, 20(sup2), S524–S541.
[43] Mwangi, A. G. (2013). Inventory management and Supply chain performance of Non-governmental organizations in the Agricultural Sector, Kenya. Unpublished MSc Thesis, Nairobi: University of Nairobi.
[44] OECD (2020), "Global value chains in agriculture and food: A synthesis of OECD analysis", OECD Food, Agriculture and Fisheries Papers, No. 139, OECD Publishing, Paris.
[45] Onggo, B. S., Panadero, J., Corlu, C. G., & Juan, A. A. (2019). Agri-Food Supply Chains with Stochastic Demands: A Multi-Period Inventory Routing Problem with Perishable Products. Simulation Modelling Practice and Theory, 101970.
[46] Otter, V., Engler, A., & Theuvsen, L. (2014). The influence of the interplay of supply chain network relationships on farmers' performance in the Chilean NTAE sector. Journal on Chain and Network Science, 14(3), 149-170.
[47] Olukunle, O. T. (2013). Challenges and Prospects of agriculture in Nigeria: The Way forward. Journal of Economics and Sustainable Development, 4(16), 37–45
[48] Oyinloye, M. (2015). Mapping Agricultural Land use Conversion and Management on Food Supply (Food Crops) in Saki West Local Government, Oyo State, Nigeria.
[49] Pastolero, A., & Sassi, M. (2022, November 4). Food loss and waste accounting: the case of the Philippine food supply chain. Bio-Based and Applied Economics, 11(3), 207–218.
[50] Pessah, S., Ferraro, D. O., Blanco, D., & Castro, R. (2022). An Integrated Ecological-Social Simulation Model of Farmer Decisions and Cropping System Performance in the Rolling Pampas (Argentina). Journal of Artificial Societies and Social Simulation, 25(1).
[51] Poi, E. L. (2018). Inventory planning and agricultural productivity in Rivers State. RSU Journal of Strategic and Internet Business, 3(2), 280-294.
[52] Popescu, G. H., Nicoale, I., Nica, E., Vasile, A. J., & Andreea, I. R. (2017, February). The influence of land-use change paradigm on Romania's agro-food trade competitiveness—An overview. Land Use Policy, 61, 293–301.
[53] Philippines - Agricultural sectors. (2024, January 23). International Trade Administration | Trade.gov. https://www.trade.gov/country-commercial-guides/philippines-agricultural-sectors
[54] Roy, T. N. (2015). Supply Chain Management of Horticultural Crops. Value Addition of Horticultural Crops: Recent Trends and Future Directions,293–314.
[55] Sakayarote, K., & Shrestha, R. P. (2019, April 17). Simulating land use for protecting food crop areas in northeast Thailand using GIS and Dyna-CLUE. Journal of Geographical Sciences/Journal of Geographical Sciences.
[56] Salerno, T. (2014, October 21). Capitalising on the financialisation of agriculture: Cargill's land investment techniques in the Philippines. Third World Quarterly, 35(9), 1709–1727.
[57] Shah, I. A. (2022). Impact of remittances on exports and economic growth: a cross country analysis. Romanian Journal of Transport Infrastructure, 12(1), 1-15.
[58] Shi, J., Zhao, Y., & Kiwanuka, R. (2015). Managing Inventories for Agricultural Products: The Optimal Selling Policies. Social Science Research Network.
[59] Shuquan, H. (2018). Agricultural trading system and global food crisis.
[60] Skalkos, D. (2022, April 29). Innovative Agrifood Supply Chain in the Post-COVID 19 Era. Sustainability, 14(9), 5359.
[61] Srinivasan, S. P., Shanthi, D. S., & Anand, A. V. (2017, June). Inventory transparency for agricultural produce through IOT. In IOP Conference Series: Materials Science and Engineering (Vol. 211, No. 1, p. 012009). IOP Publishing.
[62] Steinbuks, J., & Timilsina, G. R. (2014). Land-Use Change and Food Supply. The Impacts of Biofuels on the Economy, Environment, and Poverty, 91–102.
[63] Teklehaimanot, H., Negassa, S., & Regassa, T. (2014). The practice of inventory management in Ethiopia commodity exchange in case of hawassa & hummera warehouses (Doctoral dissertation, St. Mary's University).
[64] Titlo, N., & Sopadang, A. (2019, January). Factors affecting the performance of cold chain for export of Thailand's Longan fruit. In Proceedings of the International Conference on Industrial Engineering and Operations Management-2019 (pp. 516-526).
[65] Umanailo, M. C. B., Bugis, M., Lionardo, A., Sangadji, M., & Kembauw, E. (2021). Agricultural Land Conversion and the Influence of the Food Supply Chain. Psychology and Education Journal, 58(1), 5518-5525.
[66] Underhill, S. (2013). Improving The Effectiveness of Small-Holder Farm Postharvest Practices in Fiji. Acta Horticulture, 1011, 41–48.
[67] Value chain development for decent work. (2021). International Labour Organization. https://www.ilo.org/publications/value-chain-development-decent-work-1
[68] Wattanutchariya, W., Tansuchat, R., & Ruennareenard, J. (2016, March). Supply chain management of Thai parboiled rice for export. In International Conference on Industrial Engineering and Operations Management (pp. 8-10).
[69] Welteji, D. (2018). A critical review of rural development policy of Ethiopia: access, utilization and coverage. Agriculture & Food Security, 7(1).
[70] Yusmiati, Y., Machfud, M., Marimin, M., & Sunarti, T. C. (2023, June 2). Sustainability performance assessment of sago industry supply chain using a multi-criteria adaptive fuzzy inference model. F1000Research, 12, 593.
[71] Zhao, H., Liu, S., Tian, C., Yan, G., & Wang, D. (2018). An overview of current status of cold chain in China. International journal of refrigeration, 88, 483-495.
[72] Zhuang, D., Abbas, J., Al-Sulaiti, K., Fahlevi, M., Aljuaid, M., & Saniuk, S. (2022, November 7). Land-use and food security in energy transition: Role of food supply. Frontiers in Sustainable Food Systems, 6.