Rice Value Chain Analysis in the Philippines: Value Addition, Constraints, and Upgrading Strategies

Alice B. Mataia,[ab] Jesusa C. Beltran,[ac] Rowena G. Manalili,[ad] Betzaida M. Catudan,[ae] Nefriend M. Francisco,[af] and Adrielle C. Flores[ag]

[a]Philippine Rice Research Institute, Nueva Ecija, Philippines; [b]abmataia@philrice.gov.ph; [c]jcbeltran@philrice.gov.ph; [d]rgmanalili@philrice.gov.ph; [e]bmcatudan@philrice.gov.ph; [f]nm.francisco@philrice.gov.ph; [g]ac.flores@philrice.gov.ph

ABSTRACT

Using the value chain analysis (VCA) framework, this research analyzed the rice value chain (RVC) in the Philippines, examined the value additions, identified constraints, and proposed upgrading strategies to enhance the competitiveness of the rice industry and the specific segments in the RVC. Primary data were derived from key informant interviews in government and non-government agencies, surveys from farmers, paddy traders, millers, wholesalers, wholesaler-retailers, and retailers in 20 major rice-producing provinces and demand centers. Stakeholders' workshops were also conducted to validate the preliminary findings and identify upgrading strategies. Descriptive and economic approaches were applied in data analysis.

The country's RVC starts with the provision of inputs to produce paddy, and ends with the consumption of milled rice. The RVC is dominated by a traditional multi-layered supply chain with interconnected chain actors composed of competing farmers, paddy traders, millers, and rice traders in each segment and, oftentimes, with the engagement of brokers in both paddy aggregation and rice distribution, thereby, increasing marketing cost. The major constraints identified in the RVC included high production and marketing costs of paddy and rice attributed to low yield, high labor cost and material inputs, and insufficient crucial infrastructure and market facilities (e.g., modern mills, dryer, cheap transport, and energy), which result in high domestic paddy and rice prices, and low competitiveness of the entire rice VC. To enhance the level of competitiveness, the rice industry should concentrate on generating and promoting yield-increasing, postharvest loss-reducing, and cost-minimizing technologies, as well as those that improve overall efficiency in the RVC such as investments in enabling infrastructure, and facilities for transport, handling, storage, drying and milling.

Keywords: rice value chain, value addition, constraints, upgrading strategies, competitiveness

JEL Classification: Q3

Contact Alice B. Mataia abmataia@philrice.gov.ph https://doi.org/10.37801/ajad2020.17.2.2

INTRODUCTION

In the Philippines, rice is one of the most important crops not only because it is the staple food of the majority of the Filipinos, but also because it provides a source of income to its large chain of stakeholders on the demand and supply sides. The rice industry includes more than three million farmers and their families, thousands of traders, millers, retailers, and individuals employed in the production, processing, and marketing of its related products (Intal and Garcia 2005). Owing to its significant contribution to the country's economic development, the government has initiated programs to increase productivity and improve the competitiveness of the rice sector.

Within 1997–2007, rice productivity in the country grew by 30 percent from 2.93 to 3.80 t/ha. This was attributed to the adoption of high-quality seeds (hybrid and certified), increased irrigation investment, and use of improved location-specific technologies (Mataia et al. 2011). The annual increase for 2008–2016 was 1.23 percent (PSA 2017). Despite this remarkable yield growth, Philippine rice is not competitive as domestic prices are much higher than in its neighbors in Southeast Asia, both at the farmgate and retail levels (Bordey et al. 2016). In 2014 and 2015, domestic rice was about 50 percent more expensive than imported rice. Moreover, price data from the Philippine Statistics Authority (PSA) show large price margins between farmgate and retail prices. Some analysts attribute this wide price spread to inefficiencies along the RVC, which was characterized by high production and marketing costs, driving the domestic price above that of the world market. The implementation of the Rice Trade Liberalization law, starting in 2019, further poses a considerable challenge to the rice industry, particularly to farmers. This is aggravated by the imposition of trade restrictions due to COVID-19 in major exporting ASEAN countries, which disrupt specific aspects of the rice (and food) value chains such as processing, supply, trade chains, and final demand.

Facing the challenge of a liberalized and a more competitive rice market under the pandemic, farmers and other market players must overcome impediments along the rice value chain. This study provides information to understand the structure of rice markets, relationships among market players, value addition in the rice chain, as well as production, processing and marketing constraints that limit the competitiveness of the Philippine rice industry.

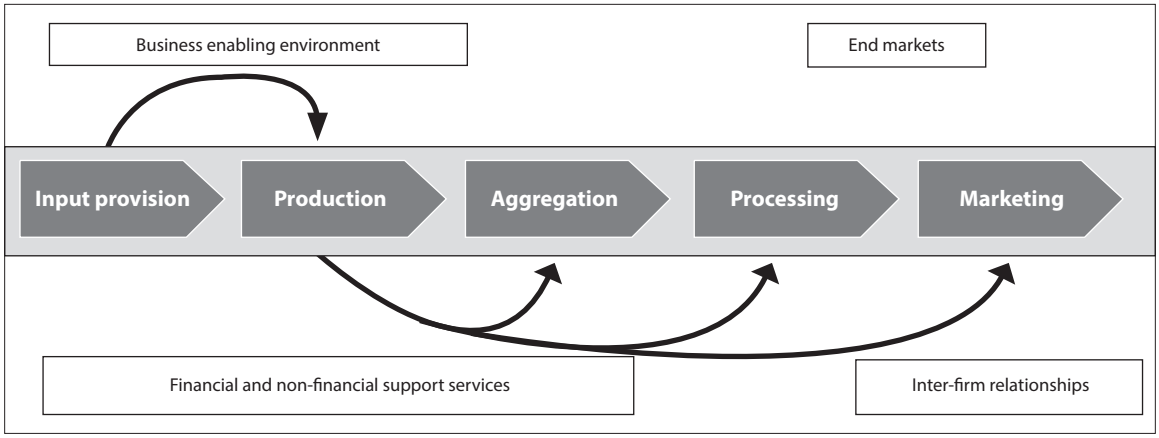
Specifically, this paper 1) undertakes an overview of the Philippine rice industry; 2) examines the nature and structure of the rice value chain indicating the geographic flow and marketing channels of paddy and milled rice, and the nature, function, and economic analysis of chain actors, 3) tracks the value addition and financial position of chain actors in each of the specific segments in the RVC; and 4) identifies constraints and draws specific policy directions and measures to enhance the competitiveness of the rice industry and specific segments in the RVC.

APPROACH AND METHODOLOGY

The Value Chain Analysis Framework

The Value Chain Analysis (VCA) framework used in the study spans the different interrelated segments or functions related to input provision, production, aggregation, processing, and marketing, which are carried out with greater interaction among the entire network of chain actors. It is influenced by four elements including end markets, support services, inter-firm relationships, and business-enabling environment. The end markets into which the final product is sold provides market opportunities and sets the parameters for the chain's growth. The chain is also supported by financial and non-financial support services that help enhance its performance. The flows of products, services, knowledge, and information in the chain is affected by quality and nature of inter-firm relationships and coordination among chain actors. Moreover, the performance of the chain and its chain actors are also governed by business-enabling environments such as policies, laws, and regulations. These elements provide insights on the strength of linkages, which can either facilitate

Figure 1. The value chain analysis framework

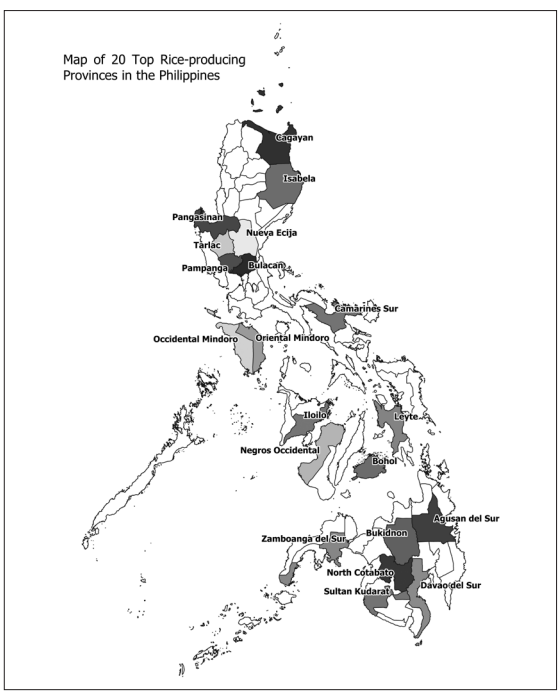


or hinder the performance of the rice value chain in terms of growth and competitiveness (Figure 1).

Selection of Study Areas

The study areas were the top 20 rice-producing provinces strategically distributed in the three major islands of the Philippines (Figure 2). The provinces were selected based on paddy production volume and their strategic importance to rice trade. Furthermore, these areas are considered the most favorable rice-growing areas in the Philippines, producing an average of 9.8–12.23 million tons per year (65% of total annual paddy produced). Each province was ranked based on its percentage share to total paddy output using 5-year average paddy production data from 2010 to 2014. Also included in the study were wholesale rice markets in Metro Manila, Cebu, Cagayan de Oro City, and Davao City, which represent the major demand trading centers of milled rice in the country. The major ports are also located in big cities where major transhipments of milled rice for domestic and import markets are carried out.

Figure 2. Administrative map of the Philippines showing the top 20 major rice-producing provinces included in the study



Data Sources and Sampling Method

Secondary data including published and unpublished and other documents, and databases obtained from relevant websites and agencies were gathered and reviewed. Primary data were collected through field survey, key informant interviews, and a stakeholders' workshop. Of the four sets of structured questionnaires used for the field surveys, one set was used for farmers while the rest were for the other value chain actors (paddy traders/assemblers, millers, and wholesalers and retailers). Farmers' rice production and marketing practices and market players' marketing and trading practices, facilities used, volume of paddy/milled rice procured and disposed, costs, and prices were collected. Market data in the 2014

wet season (WS) and 2015 dry season (DS) and the constraints per segment of the chain were also gathered.

The study surveyed 600 farmers and 409 market intermediaries through personal interviews in 20 provinces and four major cities (Table 1). Multi-stage and probability sampling methods were employed. For each sample province, the top six rice-producing municipalities were selected, from which the top rice-producing villages were chosen. From each selected village, five sample-farmers with marketed surplus of paddy were picked using simple random sampling. A tracing approach was employed in the selection of market players by mapping the marketing channels where paddy and rice pass through from production to consumption. Hence, from the sample farmers, market player-respondents involved in paddy aggregation, processing, and rice trading up to the retail level were chosen.

In addition, key informant interviews of financial and non-financial support service providers were carried out for key officials and experts from national and regional government agencies, local government units (LGUs), NGOs, and international institutions. Stakeholders' consultation workshops in the country's three major islands were also conducted in the cities of Muñoz, Iloilo, and Davao to validate salient findings and obtain approval on the identified key interventions needed to upgrade each segment in the RVC.

Methods of Data Analysis

The descriptive analysis employed tabulated statistics such as sums, means, averages, and frequencies, while the economic analysis of costs and returns looked at the profitability of producing, aggregating, processing, and marketing of rice. It also assessed the value addition created by the overall VC and the value added and margins for each actor in a specific segment of the chain.

Specifically, a farm budget structure was constructed for the profitability of rice farming using actual and imputed prices. All costs were expressed on a per-hectare basis and the equivalent

Table 1. Distribution of number of sample chain actors by major island

Major Island	Farmer	Paddy Trader		Rice Processor		
		Cooperative Paddy trader	Private paddy trader	Cooperative miller-trader	Custom miller	Miller- trader
Number of samples						
Luzon	330	3	53	2	1	49
Visayas	120	0	10	3	6	16
Mindanao	180	1	16	1	4	25
Metro Cities						
Total	**600**	**4**	**79**	**6**	**11**	**90**
Major Island	**Farmer**	**Paddy-Rice Trader**		**Rice Trader**		
		Paddy-rice trader wholesaler	Paddy-rice trader wholesaler-retailer	Wholesaler	Wholesaler retailer	Miller- trader retailer
Number of samples						
Luzon	330	1	6	2	30	21
Visayas	120	10	7	12	20	11
Mindanao	180	10	6	10	17	24
Metro Cities				12	10	10
Total	**600**	**21**	**19**	**36**	**77**	**66**

cost per kilogram was also computed. Gross revenue was calculated by multiplying rice yield (after threshing) with the paddy price. Net returns above production cost per hectare were computed using this equation:

$$\pi = (y \times p) - \left(\sum_j \chi_j\right) \{j \in \{seed, fertilizer, pesticide, labor, irrigation, land, others\}\} \quad (1)$$

where π is net returns, y is rice yield, p is price of paddy, and $\chi's$ are the cost items.

The study also estimated the costs and returns per kilogram of paddy and milled rice at different segments of the RVC based on data and information gathered from each of the different market players. Relevant costs included the cost of product and marketing costs. Net returns represented the difference between gross returns and total costs of each player. Moreover, the economic analysis used these conversion factors: 1) conversion from fresh to dry weight paddy at 14 percent moisture content (MC) and 2) conversion of paddy to milled rice equivalent using a milling ratio of 63.88 percent. In the analysis, the equivalent price of dry paddy was computed by adjusting the wet paddy to 14 percent MC, which is ready for milling. This adjustment to farmgate price does not include drying costs but is just a physical adjustment factor to standardize MC. The equivalent price of dry paddy (p_d) is computed by multiplying the water adjustment factor and the farmgate price. Mathematically, it is described as:

$$p_d = p_f \frac{(1-0.14)}{(1-MC)} \quad (2)$$

where p_f is the farmgate price of wet paddy; MC is the moisture content of wet paddy as sold by the farmer, as a fraction of one. The milled rice equivalent of dry paddy was also estimated. The formula used is described as:

$$p_r = p_f \frac{(1-0.14)}{(1-MC)} \times \frac{1}{MR} \quad (3)$$

where p_r is defined as the price of 1 kg of dry paddy in milled rice equivalent; p_f is the farmgate price of wet paddy; MC is the moisture content of wet paddy; and MR is milling recovery, i.e., the yield of milled rice as a fraction of one. The adjusted p_f is then divided by MR to generate p_r.

Limitation of the Study

The analysis of the rice value chain is limited only to the Philippines at the national level based on the survey data gathered from VC actors in the top 20 major rice-producing provinces in the country. It did not include an analysis of island or regional comparisons. Moreover, results were presented on averages such as yields, prices, and costs, which hide some essential information on the complete and real situation of domestic rice VCs.

RESULTS AND DISCUSSION

Overview of the Rice Industry

Forms and uses of rice

More than a staple food to millions of Filipinos, rice is utilized as processed food with added value made from its various forms—rough, brown, milled, broken, flour, and starch (Juliano and Hicks 1996). Rice by-products of straw, hull, and bran are also becoming important sources of raw material for industry use, generating new income opportunities for some in the rice sector. There are also non-edible products from rice and rice by-products, e.g., cosmetics, pharmaceuticals, and rice bran oil products. However, the processing of rice bran oil and other non-edible food for commercialization is not that advanced in the country because of the high price of raw material.

Domestic paddy production

The Philippines placed seventh among the top rice-producing countries in the world in 2014 with a share of around 3 percent to global rice production. It achieved the highest production in 2014 (18.97 million t) produced from 4.74 million ha at 4 t/ha average yield. From 2005 to 2014,

production increased by 24 percent, from 14.6 million tons in 2005 to 18.15 million tons in 2015. During this period, production has increased at an average of 2.2 percent per year with the highest growth of 7.48 percent recorded in 2012. This was brought about by increases in yield (0.79% per year) and area harvested (1.31% per year). The performance in yield, however, was lower from 1997–2007 when yield grew by around 3 percent per year. The increase in the adoption of certified seeds and investment in irrigation were the major factors that contributed to the increase in yield (Mataia et al. 2011). Accordingly, self-sufficiency level has improved at 81 percent in 2010 to almost 97 percent in 2013, then slightly going down to 92 percent in 2014 (PSA 2015).

Rice production has been concentrated in Luzon, producing 59 percent (10.71 million tons) of the country's total paddy production in 2015, which came from 2.55 million ha with average yield of 4.21 t/ha. The Visayan islands supply 18.45 percent (3.35 million t) of the country's total paddy production from 0.99 million ha rice area. Average yield in 2015 was 3.37 t/ha, which was below national yield average (3.90 t/ha), mainly because a big portion of the area is rainfed. Mindanao posted 4.09 million t paddy production from 1.12 million ha of rice area at an average yield of 3.66 t/ha, placing it second to Luzon (22.53% of total production). For 2005–2015, production growth was more pronounced in Luzon at an average of 2.65 percent per year than Visayas (1.79%) and Mindanao islands (1.49%), where area expansion (1.67%) contributed more in the growth than in yield improvement (0.79%).

Among the regions, the bulk of production came from Central Luzon (18%), Cagayan Valley (13.72%), Western Visayas (11.33%), Ilocos Region (9.79%), SOCCSKSARGEN (7.12%), and Bicol at around 7 percent (Table 2). These regions also have the largest rice area harvested. Central Luzon (4.72 t/ha) has the highest average farm yields, and is also home to Nueva Ecija, the top rice-producing province in the country, which contributed nearly 9 percent to total domestic paddy production and 48 percent to the region.

Rice consumption and imports

Although the country has shown significant growth in paddy output, self-sufficiency level was only 92 percent in 2014, though it improved from 81 percent in 2010 (PSA 2015). Annual paddy production was observed to fall short of demand, thus necessitating rice importation. The highest import volumes were 2.4 million t and 2.3 million t in 2008 and 2010, respectively, but declined to as low as 0.405 million t in 2013. This is attributed to the country's rice self-sufficiency policy since 2011. However, at the current per capita rice consumption of 114.27 kg/yr and an annual population growth rate of about 2 percent, the country's total requirement is projected to increase, reaching 14.95 million t by 2025. Among ASEAN countries, the Philippines has the highest projected population growth rate of a cumulative 22 percent from 2012 to 2025 (Dawe et al. 2008). This indicates that the country will continue to depend on the world market to meet its domestic rice requirements. However, quantitative import restrictions (QRs) have been lifted and replaced with import tariffs, which means that the country's rice industry is expected to face increasing competition from abroad. Hence, the continuing survival of the domestic rice industry depends on its ability to compete in the global market, which largely depends on the efficiency or competitiveness of its production and marketing systems or the entire RVC.

The Nature and Structure of the Rice Value Chain

Geographic flow of paddy and milled rice

The geographical movement of paddy and milled rice explains the importance of supply areas and demand centers and the trading practices of traders. It also shows the magnitude of inter-island and interregional movement of paddy and milled rice as well as the relationships between production-consumption characteristics of the different regions, provinces, and major cities in the country. This information provided understanding on the direction of rice supply and demand, which can be used in the management of risks of rice

Table 2. Production, area, and yield growth performance

Major Island/ Region	2005–2015				
	Production		Area Harvested		Yield
	Share to total in 2015 (%)	Average growth rate (% per year)	Share to total in 2015 (%)	Average growth rate (% per year)	Average growth rate (% per year)
Philippines	**100.00**	**2.21**	**100.00**	**1.31**	**0.79**
Luzon	**59.02**	**2.65**	**54.70**	**1.67**	**0.83**
CAR	2.21	1.19	2.39	1.11	0.08
Ilocos Region	9.79	2.59	8.87	1.27	1.16
Cagayan Valley	13.72	3.15	12.54	2.11	0.84
Central Luzon	18.18	2.71	15.03	2.05	0.54
CALABARZON	2.16	0.01	2.43	0.23	–0.21
MIMAROPA	5.96	3.43	6.09	2.08	1.10
Bicol Region	6.97	2.62	7.35	1.13	1.32
Visayas	**18.45**	**1.79**	**21.33**	**0.95**	**0.76**
Western Visayas	11.33	1.29	13.37	0.54	0.71
Central Visayas	1.85	5.54	2.20	2.29	2.60
Eastern Visayas	5.27	1.92	5.76	1.51	0.36
Mindanao	**22.53**	**1.49**	**23.97**	**0.86**	**0.57**
Zamboanga Peninsula	3.65	1.6	3.51	0.29	1.27
Northern Mindanao	4.00	5.27	3.52	2.83	1.86
Davao Region	2.43	–0.55	2.13	–0.77	0.24
SOCCSKSARGEN	7.12	1.68	7.3	0.85	0.76
CARAGA	2.65	2.25	3.33	2.99	–0.56
ARMM	2.69	–0.95	4.17	–0.25	–0.72

Source: PSA (2015)

price volatility caused by supply distortions. Figure 3 shows the geographic movements of paddy and milled rice from the source of production to the final destination. Overall, paddy flowed mostly within the production area, whereas milled rice moved across marketplaces, normally from production surplus areas to major deficit trading centers. In Luzon, about 14 percent of its milled rice was supplied to the major rice-deficit provinces and cities in the Visayas and Mindanao such as Cebu, Cagayan de Oro, and Davao, while majority (86%) was consumed or flowed within the island. Central Luzon, in particular Nueva Ecija and Bulacan, which has the most number of rice mills, largely filled up the rice requirements of Metro Manila and CALABARZON, the two largest rice demand areas. In Visayas, interisland and interregional movement of rice is commonly practiced despite its topography. Cebu, in particular, received rice from different provinces in Luzon and Mindanao because of its large rice demand. However, inflows of imported rice within and from other discharging ports are usual in Cebu; thus, there were also outflows of milled rice from the province. Similarly, in Mindanao, the efficient transportation network enables the fluid movement of paddy and milled rice. As shown in the map, even the surplus and deficit regions and provinces in the island experience rice inflows and outflows.

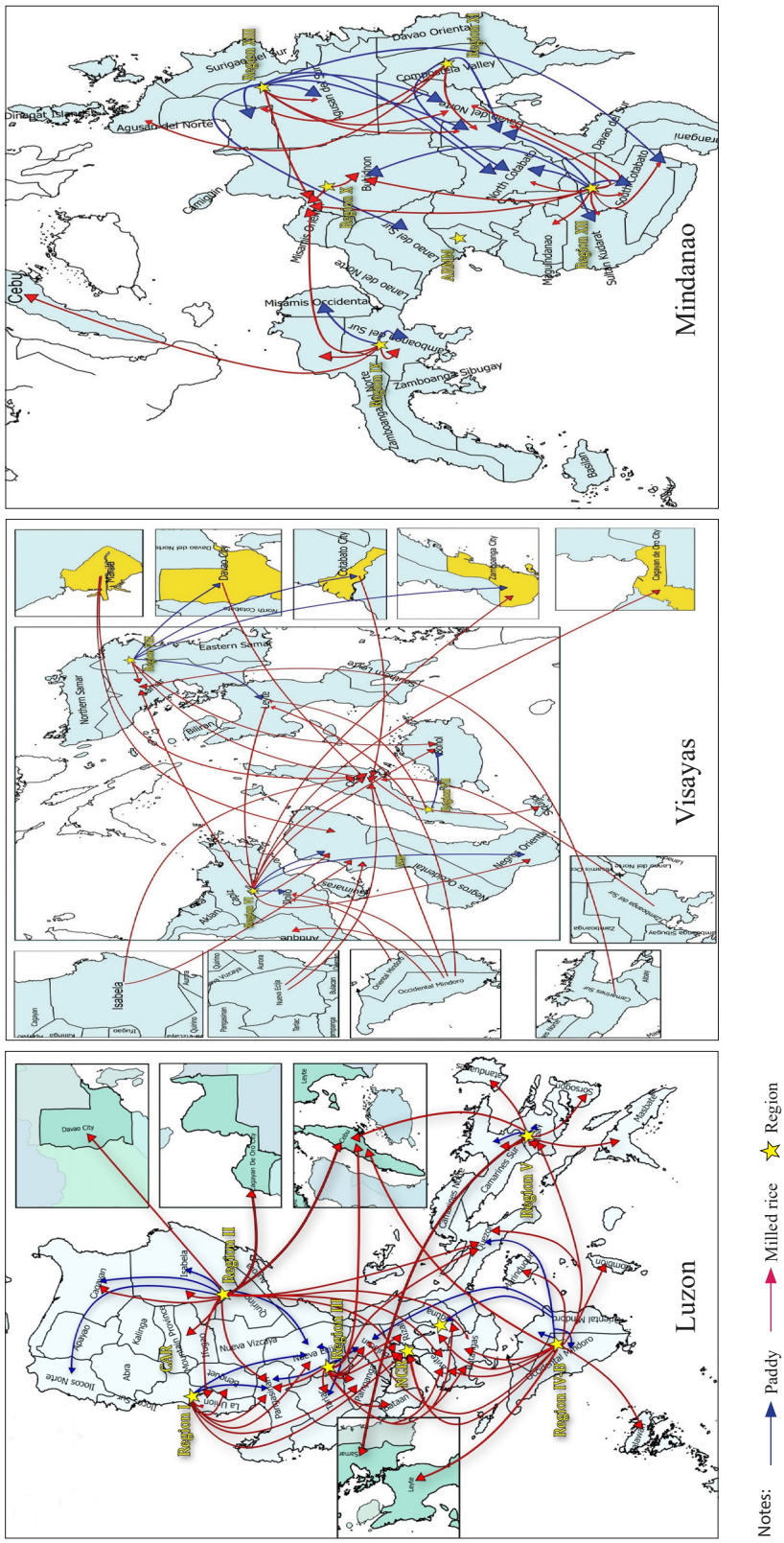


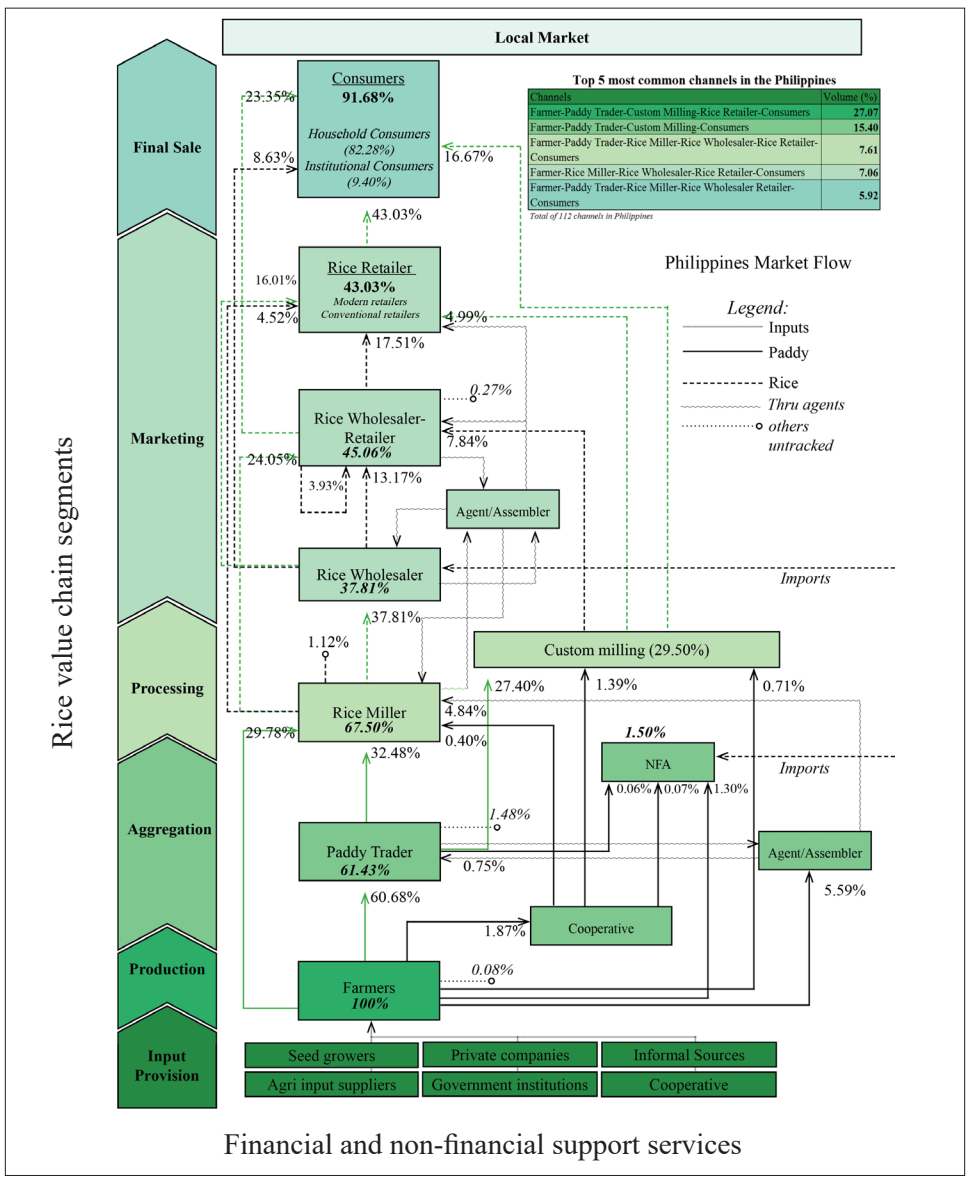
Figure 3. Geographic flow of paddy and milled rice, by island, Philippines (2015)

Rice value chain map and marketing channels of paddy and milled rice in the Philippines

Figure 4 shows the rice value chain that starts from the provision of inputs for paddy production, then on through aggregation, processing, marketing, and delivery for final use by consumers. These stages of the rice VC involve greater interaction among chain actors from the farmers to consumers through value-adding activities. Government agencies and NGOs also provide financial and non-financial support services to the rice VC to enhance its performance.

Generally, VC actors are responsible for moving the paddy and milled rice across markets in the country. Paddy and milled rice are transmitted from production surplus areas to major deficit provinces and trading centers through various market channels. In the survey areas, 112 market channels were identified in the domestic rice market. From farmers, marketed surplus paddy commonly went to paddy traders (61%) and miller-traders (36%) on account of the

Figure 4. Rice value chain map and marketing channels of paddy and milled rice



high buying farmgate price. A small percentage is sold to a cooperative (2%) and the National Food Authority (NFA) (2%). On the other hand, milled rice is exchanged at multiple levels of market players before it reaches the consumers. From miller-traders, rice passes through wholesalers, wholesaler-retailers and retailers, oftentimes with the engagement of brokers. In this channel, it was observed that paddy and rice changed possession five to seven times from the farmer to the end user, excluding the involvement of brokers both in paddy aggregation and milled rice distribution. It makes the chain "traditionally long" due to many participating actors. This traditional channel, however, is becoming less popular (top 3 of the most common channels) as the volume of paddy and milled rice handled was only eight percent of the total volume marketed in the domestic rice market.

Several transformations were observed in the structure of the domestic rice market with fewer actors, less interactions, and integration of functions, eliminating other chain actors that do not carry out value-adding activities. Increasing competition and income opportunities partly drove these changes by adding value to the products traded**.** For instance, rice traders buy paddy directly from farmers, process it through custom milling services, and sell it as milled rice in wholesale and retail markets, which eliminates the role of paddy traders. Also, rice traders buy paddy directly from farmers, avail of the services of custom milling for processing paddy to milled rice, then sell directly to end users, which eliminates paddy traders, miller-traders, wholesalers, and retailers and promotes the rise of custom milling service providers. These channels are the top two most common market channels identified from the survey areas and are increasing in scope, handling 42 percent of the volume traded in the market. This suggests that traditional channels are now changing and transitioning. Moreover, modern rice supply chains emerged with technological advancement, changes in market conditions, and increase in urbanization. Among these are the big miller-traders that mostly own modern rice mill facilities in Cagayan (i.e., Tuguegarao), Isabela, Nueva Ecija, Iloilo, Bohol (i.e., Tagbilaran), and Davao. These modern channels are more vertically integrated and more developed, carrying out functions from input provision to paddy aggregation, milling, and rice distribution up to retailing, reducing the number of market players. Such vertical integration allows these chain actors to capture all the value additions and improve their financial position in the total chain profits. There are 188 modern rice mills registered through NFA across the country (NFA 2015).

There are also few individual farmers and farmers' cooperatives involved in the rice supply chain, which are shorter and compressed as they directly distribute to institutional buyers or households. In this channel, cooperatives and individual farmers make incremental profit for additional value-adding activities than merely marketing paddy. Despite potentially large profit margins, few engage in multiple value-adding activities in the rice market chain due to limited technical, entrepreneurial, financial management, and trading skills. A government supply chain represented by the NFA also exists, which is relatively shorter. However, it plays a minor role in paddy procurement, procuring only around 2 percent of total production (Figure 4).

Chain actors and functions in the rice value chain

Paddy production. Farmers are the key actors in the production of paddy in the RVC. On the average, sample farmers were 53 years old, had 9 years schooling, and only 8 percent are members of cooperatives.

An estimated 2.4 million farmers are engaged in rice production in the Philippines. Based on 2011–2012 rice-based farm households survey, rice farming is generally small scale: more than half (54%) cultivate an area less than 1 ha; 27 percent plant in 1–2 ha; 10 percent, 2–3 ha; and only 9 percent operate in fields above 3 ha. Paddy producers perform the following farm activities: seed selection, land preparation, crop establishment, crop care and maintenance (such as nutrient management, pest management, and

water management), harvesting and threshing, and hauling. Majority (92%) procure material inputs, particularly fertilizer and pesticides, from agricultural input stores or input dealers. The high price of material inputs constrains the farmers-respondents' easy access to inputs.

About 164 unique rice varieties were planted in the surveyed provinces and these were chosen based on consistent high yield and high market demand. More than half used certified seeds (63% during wet season [WS] and 55% during dry season [DS]). Hybrid seed users accounted for 12 percent and 17 percent during WS and DS, respectively.

Land preparation is generally mechanized with 90 percent of the farmers using small tractors. On the average, 9–10 man-days/ha were utilized for land preparation, considerably higher than in Vietnam (2.4 mandays [md]/ha) and Thailand (1.8 md/ha), due to the use of small tractors. High labor and power cost, unavailability of laborers and machines during peak farm operations, and insufficient water supply constrained land preparation.

In crop establishment, manual transplanting was most practiced in both seasons (69% WS and 66% DS), entailing 21 md/ha and making it one of the most labor intensive farm operations compared with the 2 man-days/ha needed for direct seeding method. Average fertilizer application rate across ecosystem was 6.23 bags/ha during WS and 6.74 bags/ha during DS, which are still below the recommended rates. The high price of fertilizers prevented farmers from applying the required amounts of fertilizers. Urea (45-0-0), complete (14-14-14), 21-0-0 (ammonium sulfate), and 16-20-0 were the most commonly used fertilizer grades. Other fertilizers such as 0-0-60 and 17-0-17 were also applied in small quantity. Farmers also applied pesticides and herbicides (32 kg ai/li/ha[1] in WS and 40 kg ai/li/ha in DS) as substitute for manual weeding due to high farm wage. Insecticide application was done with and without insect occurrence for preventive and corrective purposes.

Manual harvesting and threshing using small axial threshers are commonly practiced, which utilized around 20 md/ha, contributing 31–32 percent to total labor use. Currently, custom hiring of combine harvester is also becoming popular owing to the economic benefits that the machine offers (i.e., greater labor and cost efficiency). Arida et al. (2016) reported that the use of a combine harvester requires only around 2–5 md to finish a hectare of paddy. It also ensures timeliness of harvesting, preventing significant grain losses, and addresses labor shortage during harvesting.

Farmers did not sell the entire paddy in the market—part went to harvesters/threshers' share (12%); home consumption (9%); payment to laborers (5%); payment to landlord (2%); kept for seed (1%); and used to pay creditors (2%), irrigation fee, or given away. What is left is called the marketable surplus—the quantity available for sale, averaging 70 percent of the total harvest. Upon harvest, farmers solicit multiple price bids from an average of three market intermediaries and decide where they will sell their produce. Majority (71%) sold paddy in fresh form due to limited access to postharvest facilities and immediate need for cash to pay for crop production loans.

Paddy aggregation. Paddy traders are market players who engage solely in paddy trading, i.e., collecting paddy for sale to large miller-traders who do not have the time to procure from scattered small farmers. Their marketing activities involve drying, trucking, handling, and storing. Only 23 percent have membership in any business associations, meaning that their relationships with co-actors are relatively weak. This observation can be explained by the seasonality of paddy trading as most of them operate only during harvest season. On the other hand, the vertical relationship between farmers and paddy traders is one of the strongest among actors in the rice supply chain. Based on the survey, farmers supplied 94 percent of the total volume procured by paddy traders. A solid interdependence also exists between these two actors. Most farmers need financing for rice production and paddy traders want an assured source of the produce to supply to miller-

1 Active ingredient per liter per hectare

traders. Hence, the latter (68%) often provide credit to farmers in both cash and material inputs. Payment is in kind, which is equivalent to the loan principal and interest. Paddy traders set the loan terms including the maximum amount a farmer borrower can avail, interest rate, and repayment arrangements. The average loan amount is PHP 36,838 with an interest rate of 3 percent per month for a four-month period, which is lower than that offered by private moneylenders. This practice has established long-term trading relationships (*suki*) between farmers and paddy traders. The price of paddy paid by creditor-traders is based on the prevailing procurement price, contrary to expectations that farmers tied to creditor-traders would receive lower prices for paddy as effective interest on the loans.

Millers also provide advance credit to paddy traders for paddy aggregation to ensure a steady supply of paddy to sustain their milling and trading operations; hence, a strong vertical linkage also exists between these chain actors. In the survey, 92 percent of the volume of paddy aggregated by paddy traders was sold to miller traders.

Traders pick up freshly threshed paddy from farmers' fields using small trucks to haul produce through narrow farm roads. This relieves farmers of transport costs, but entails high transportation costs for the traders. For paddy disposal, large trucks with big load capacity such as 10-wheelers (25 t), forward (12 t), and trailers (32 t) are used to accommodate large volumes and to reduce cost. During procurement and disposal, manual paddy handling translates to high handling cost from an average of 3–4 moves, for which payments are made per move. Payment for the services of agents at PHP 0.10–0.20 per kg of aggregated paddy also increases handling cost. Additional losses are incurred during weighing in paddy aggregation when small weighing scales (50–100 kg capacity) predisposed to weight manipulation are typically used. Hence, farmers repeatedly complain of inaccurate weights.

Quality assessment of paddy grains is based on physical criteria: percent MC, appearance, presence of foreign material, and impurities. MC is assessed by hard-pressing the grain or biting it, but farmers think this practice does not determine actual MC. From the survey, very few (3%–5%) paddy traders have their own moisture meters. Sun drying in major highways is also commonly practiced by most paddy traders primarily because it is relatively cheaper than mechanical drying (Table 3). However, sun drying reduces quantity and quality of milled rice by 3–5 percent, resulting in low quality and market value of milled rice. Salvador et al. (2012) reported an average of 5.86 percent loss attributed to drying.

Procurement prices of paddy are based on the buying price of miller-traders (as reported by 85% of the paddy traders), prevailing price, and grain quality (% MC and appearance). Normally, the WS harvest has low-quality due to the rainy season. Sometimes, buyers stopped purchasing fresh paddy (undried) from farmers because of oversupply and limited drying facilities, which forced farmers to sell their produce at a very low price. Mixing of different varieties before disposal was also a common practice, as reported by 11 percent of paddy traders. However, NSIC Rc218 and NSIC Rc160 varieties are separated because of their premium eating quality. They are

Table 3. Drying practices according to market player (%)

Drying practice	Paddy Traders	Paddy-Rice Traders	Cooperative Miller-Traders	Custom Millers	Miller-Traders
n	72	39	6	11	90
Solar drying	71	47	45	33	31
Mechanical drying	15	22	50	67	30
Both	14	31	5		39

Source: Survey of market players (2015)

also sold as special rice at premium prices in the local market. The rest of the varieties are termed "rumble" (mix) and are priced lower than these two varieties.

Processing/milling. Rice processing (transforming paddy into rice) is performed by custom millers and miller-traders. In 2015, a total of 8,249 rice millers were licensed to operate, 60 percent of which are concentrated in Luzon. Bulacan accommodates 125 and 15 rice mills in Intercity and Golden City, respectively, while Nueva Ecija hosts 139 rice mills. The high concentration of millers in Central Luzon suggests that it is a hub to modern, large miller-traders who are also licensed importers that supply rice to co-miller-traders and wholesalers. Intercity and Golden City in Bocaue, Bulacan serve as a central area for rice wholesaling for wholesalers and wholesaler-retailers in Metro Manila and most provinces in Region 4-A.

Millers have been in the business for an average of 19 years. Formal linkages among rice millers appear to be strong as reflected by the membership of 43 percent in business-related organizations. The organization allowed millers to agree on the buying price of paddy, share market information, invoke fair competition among members, and hence, control the price at the farm level.

The main activities in rice processing are milling, classifying, packaging, storage, and distribution, which are mostly done by miller-traders whose tasks are vertically integrated from paddy procurement, trucking, drying, milling, to rice wholesaling and retailing (as some also own retail shops in public markets and malls). In the survey areas, 92 percent of the volume of the paddy procured by traders nationwide was marketed to rice millers for milling, which indicates a strong vertical linkage between paddy traders and rice millers. Mixing varieties is commonly practiced by miller-traders as it is laborious to segregate numerous varieties from various suppliers and from different areas, and there is a need to achieve economies of scale. However, they segregated varieties with high market potential to maintain quality and meet the demand for high-quality rice by modern retailers and high-end consumers.

A large portion (64%) owns milling equipment with capacities of 2–5 t/hr while a few (19%) own equipment capable of 5–10 t/hr and above. However, 18 percent of the miller-respondents have mills with less than 2 t/hr capacities, which are less efficient and unable to produce rice that meet quality standards. They could be less competitive in the highly demand-driven rice market. Most cooperatives on the other hand, used 2 t/hr capacity mills. Generally, mills are underutilized (94% per year) because of: seasonality and low supply of paddy due to strong competition, rice importation that limits the demand for local rice, and labor shortage. Cooperative rice mills are the most underutilized (42% per year) and are often idle, mainly due to limited procurement fund (Table 4). High price of electricity and labor are some of the major constraints in milling operation, which resulted in high milling cost. Capacity utilization of rice mill was computed by this simple mathematical equation:

$$x = \frac{\left(\text{no. of}\frac{\text{hrs}}{\text{day}} * \frac{\text{day}}{\text{week}} * \frac{\text{month}}{\text{year}}\right) * 4/(8\text{hrs})}{365}$$

Packaging and labeling are additional costs to miller-traders in their functions, and this cost is dependent on the material's quality. Based on the survey data, the average price of an ordinary sack used for paddy was PHP 9/piece, while sack with simple labels cost PHP 12/piece. Laminated and labeled sacks were more expensive at PHP 20–30/piece and these are considered disposable when sold. Rice is usually packed in 25 kg and 50 kg bags and in small packages of 10-, 5-, and 2-kg each, depending on the agreement between miller-traders and buyers. Miller-traders also store the paddy due to supply fluctuations, which impacts price, particularly during lean periods of supply. Warehouses are the common types of storage facilities used.

Table 4. Milling operation, by type of processor

Item	All	Cooperative Miller-Traders	Custom Millers	Miller-Traders
N	107	6	11	90
Percent capacity utilization (operation/year @ 8 hr/md)	94	42	97	96
Mean number of months per year	10.2	5.5	11.2	10.3
Mean number of days per week	5.7	5.6	4.4	5.8
Mean number of hours per day	11.9	10	14.3	11.8
Average volume of paddy milled (t/day)	60	47	67	60
Proportion of annual milling operation				
Own mill (%)	71	32		80
Custom mill (%)	23	10	97	16

Marketing/distribution. The next segment in the RVC is the marketing function including delivery of milled rice from the mills to the distribution channels to final users. It also involves rice trading, transportation/shipping, and storage. This function involves rice traders consisting of an established network of wholesalers, wholesaler-retailers, and retailers. NFA released licenses to 4,052 wholesalers and 61,463 retailers in 2015. This means that wholesaling is less competitive, which is mostly controlled by few highly capitalized traders located in Binondo in Manila and in Cebu City. These actors have strong linkages and are largely organized and have control over the price of milled rice. On the contrary, retailing is highly competitive considering the number of retailers and the main function, which is rice distribution to consumers. Traditional and modern retailers exist in the local market. Modern retailers like supermarkets, hypermarkets, and grocery stores cater to different socioeconomic classes by offering convenience and quality to meet the preferences of consumers.

Most of the large rice traders also availed of agent services to contact suppliers of milled rice. As in paddy aggregation, some agents act as brokers between miller-traders and rice traders (wholesalers or wholesaler-retailers) on a commission fee. Prices of milled rice depend on quality, milling grade classification, and prevailing prices. Grain quality was the main factor considered by buyers, followed by price. The demand for rice of premium eating quality is increasing as more middle- and high-income consumers shift preference.

Economic analysis

As shown in Figure 4, paddy and milled rice pass through several hands from the farmers to consumers involving a set of interconnected chain actors: farmers, paddy traders, miller-traders, wholesalers, and retailers, who each adds economic value to rice as it moves through the chain. These values then add up to the final price of rice in the final market. As a result, the purchased price of milled rice increases as it journeys toward the consumers. In assessing the value addition in the entire RVC, cost and return by segment in the chain was first analyzed. Tables 5 to 8 show the estimated costs and returns of paddy production, paddy trading, rice milling, rice wholesaling and retailing.

Cost and returns analysis of paddy production

At an average yield (fresh weight) of 4.551 t/ha and price of PHP 16.31/kg, this would give gross returns in paddy production of PHP 74,230/ha. The average production cost is PHP 48,471/ha, translating to a cost of PHP 10.65/kg. Among production cost items, labor has the biggest share (50%)—hired labor represents 39 percent of the total production

expenses owing to the common practice of manual transplanting, which is labor-intensive. Generally, harvesting and threshing labor are paid on crop-share basis, at an increasing rate if paddy yield and price of paddy rises. Land rent has a cost share of around 16 percent, attributed to the increasing land demand from non-agricultural sectors and high value crops, and decline of productive land. Fertilizer was 9.7 percent of cost share, given its high price, while seeds had a 5 percent share, owing to the farmers' high seeding rate practice. Relatively low yield also contributed to high unit production costs, with most of the farmers still obtaining yields below the national average of 4 t/ha (at 14% MC). The average net returns was PHP 25,759/ha, or PHP 30,226/ha (WS) and PHP 23,379/ha (DS), translating into net profit per kilogram paddy of PHP 5.66 (PHP 6.66/kg [WS] and PHP 5.12/kg [DS]). The profit cost ratio was 0.53 (Table 5).

Cost and returns analysis of paddy trading

Paddy traders procure fresh paddy directly from farmers and sell it as dry paddy to miller-traders, which means that the procured fresh paddy at an average of 22 percent MC was dried up to 14 percent MC. The paddy traders incur a total cost of PHP 18.86/kg, 95 percent (PHP 17.98/kg) of which the cost was due to the procurement price of fresh paddy changed as dry price equivalent. Besides the cost of dry paddy, traders also incurred marketing cost of PHP 0.88/kg (5% of total costs). Dry paddy price equivalent is the price of fresh paddy adjusted to 14 percent

Table 5. Costs and returns of paddy production (fresh weight, by season)

Item	2014 WS	2015 DS	Average	Cost Share (%)
Returns				
Yield (kg/ha)	4,535	4,567	4,551	
Price of paddy (PHP/kg)	17.69	15.39	16.31	
Gross Returns (PHP/ha)	80,240.00	70,307.00	74,230.00	
Costs (PHP/ha)				
Seed	2,531.00	2,190.00	2,361.00	4.87
Fertilizer	4,770.00	4,584.00	4,677.00	9.65
Chemicals	1,298.00	1,248.00	1,273.00	2.63
Hired labor	19,705.00	18,172.00	18,939.00	39.07
Operator, family, and exchange labor	5,036.00	5,711.00	5,374.00	11.09
Animal, machine, fuel, and oil	2,019.00	2,337.00	2,178.00	4.49
Irrigation/drainage	548.00	751.00	650.00	1.34
Food	1,011.00	979.00	995.00	2.05
Transportation	180.00	166.00	173.00	0.36
Tax	193.00	185.00	189.00	0.39
Land rent	8,486.00	6,542.00	7,514.00	15.50
Interest cost	1,580.00	1,555.00	1,568.00	3.23
Other inputs	2,657.00	2,508.00	2,583.00	5.33
Total Costs (PHP/ha)	**50,014.00**	**46,928.00**	**48,471.00**	
Total Costs (PHP/kg)	**11.03**	**10.28**	**10.65**	
Net Profit (PHP/ha)	**30,226.00**	**23,379.00**	**26,806.00**	
Net Profit (PHP/kg)	**6.66**	**5.12**	**5.66**	
Net Profit-Cost Ratio	**0.60**	**0.50**	**0.53**	

Note: USD 1.00 = PHP 47.00 (2015)

MC. It usually reflects the cost of shrinkage losses (loss in weight due to drying from 22% to 14% MC), valued at PHP 1.67/kg. Of the marketing costs, transportation had the biggest cost share (31%) followed by drying (18%) and handling (17%). The high transportation cost was due to poor road infrastructure preventing paddy traders from using large trucks and high price of fuel, oil, and driver's fee. Paddy traders received PHP 0.51/kg in profit for selling dry paddy at an average price of PHP 19.37/kg (Table 6).

Cost and returns analysis of rice milling

Though miller-traders perform integrated functions in the rice chain, the cost and return analysis was limited only to millers' procurement of dry paddy from traders, milling, and selling milled rice. In this case, miller-traders have no drying cost because paddy traders already assumed the cost of drying and shrinkage losses. They incurred total costs of PHP 33.89/kg, in which paddy cost was PHP 30.32/kg (90% of total costs) and marketing cost was PHP 3.57/kg (10% of total costs). Paddy cost includes the procurement price of dry paddy converted into milled rice cost equivalent, estimated by dividing the dry paddy price per kg to the milling recovery at an average of 63.88 percent. Of the marketing costs, milling registered the biggest at PHP 1.18/kg (33%) including labor and energy used. This is largely attributed to lower economies of scale and underutilization of rice mills due to lower volume of supply of paddy. Most of the rice mills in the country do not operate at full capacity (8 hrs/day during ordinary season and 16 hrs/day at peak periods) as compared with those in Thailand and Vietnam (24 hours daily) that operate at this level most of the time (Beltran et al. 2016). Administrative cost was PHP 0.74/kg (21%) and transportation cost was PHP 0.62/kg (17%). The other marketing expenses incurred were on cost of working capital (11%), packaging (9%), handling (8%), and storage (1%). At an average selling price of rice of PHP 35.86/kg and total cost of PHP 33.89/kg, millers gained net profit of PHP 1.97/kg. Adding the value of

Table 6. Cost and returns of paddy trading

Item	Price/ Cost	Cost Share (%)
Gross Returns (PHP/kg)		
Selling price of dry *palay*	19.37	
Costs (PHP/kg)		
Procurement price of fresh *palay*	16.31	
Dry equivalent procurement price of *palay*	17.98	95
Marketing costs:	0.88	5
Drying	0.16	18
Storage	0.03	3
Packaging	0.10	11
Transportation	0.27	31
Handling	0.15	17
Administrative	0.11	12
Cost of working capital	0.06	7
Total Costs (PHP/kg)	**18.86**	
Net Profit (PHP/kg)	**0.51**	

Table 7. Cost and returns of rice milling

Item	Price/ Cost	Cost Share (%)
Gross Returns (PHP/kg)		
Selling price of milled rice	35.86	
Selling price of *palay* by-products	0.46	
Total returns	36.32	
Costs (PHP/kg):		
Procurement price of dry *palay*	19.37	
Rice equivalent procurement price of dry *palay*	30.32	90
Marketing costs:	3.57	10
Drying		
Milling	1.18	33
Packaging	0.32	9
Storage	0.04	1
Transportation	0.62	17
Handling	0.28	8
Administrative	0.74	21
Cost of working capital	0.40	11
Total Costs (PHP/kg)	**33.89**	**100**
Net Profit (PHP/kg)	**2.43**	

by-products at PHP 0.46/kg, the total net profit earned was PHP 2.43/kg of milled rice (Table 7).

Cost and returns analysis of rice wholesaling

The analysis of costs and returns of wholesaling is a subtraction of total cost from the selling price of milled rice. In this analysis, the cost of milled rice is the procurement cost of wholesalers, which was the selling price of millers as reported in Table 7. Wholesalers obtained total cost of PHP 37.27/kg covering the procurement price of milled rice (PHP 35.86/kg) and marketing cost (PHP 1.41/kg). Administrative cost constituted the biggest share (48%) of the marketing expenses, followed by transportation/shipping (27%), and working capital (15%). At an average selling price of PHP 38.51/kg, wholesalers obtained a net profit of PHP 1.24/kg (Table 8).

Cost and returns analysis of rice retailing

The total costs incurred by retailers was PHP 39.68/kg, consisting of the costs of procurement of milled rice (PHP 38.51/kg) and marketing (PHP 1.17/kg). As consumers directly buy milled rice from retail stores, retailers do not incur delivery cost. Administrative cost (58%) is the highest in marketing expenses, followed by working capital (17%), packaging (11%), and handling (10%). Retailers gained a net profit of PHP 1.07/kg at the retail selling price of PHP 40.75/kg (Table 8).

Value Addition and Relative Financial Position of Value Chain Actors

A core element of the RVC is to map the monetary value—total costs, selling prices, profits, and margins were estimated per stage to decompose the unit value added, profit and margin. The retail price of milled rice (price paid by the consumers) in the market measures the total value addition, decomposed from production of paddy to marketing of rice at the retail market. Table 9 shows the value addition created at every stage in the RVC and the relative financial positions of chain actors in carrying out their specific functions.

Farmers as producers of fresh paddy spent PHP 10.87/kg and received a net profit of PHP 5.66/kg at a selling price of PHP 16.31/kg. Paddy traders, the second actor in the chain incurred an added cost of PHP 2.55/kg, which translated to a total cost of PHP 18.86/kg (procurement price of fresh paddy and added unit cost). They earned PHP 0.51/kg as consolidator and for selling dry paddy to the miller. The added unit cost was attributed to loss in weight due to drying from

Table 8. Cost and returns of rice wholesaling and retailing

Item	Wholesaling		Retailing	
	Price/Cost	Cost Share (%)	Price/Cost	Cost Share (%)
Gross Returns (PHP/kg)				
Selling price of milled rice	38.51		40.75	
Costs (PHP/kg)				
Procurement price of milled rice	35.86	96	38.51	97
Marketing costs	1.40	4	1.17	3
Packaging			0.11	10
Storage	0.02	1	0.02	1
Transportation/shipping	0.38	27	0.38	32
Handling	0.10	7	0.13	11
Administrative	0.68	48	0.68	58
Cost of working capital	0.20	14	0.20	17
Other costs	0.03	2	0.03	3
Total Costs (PHP/kg)	**37.26**		**39.68**	
Net Profit (PHP/kg)	**1.24**		**1.07**	

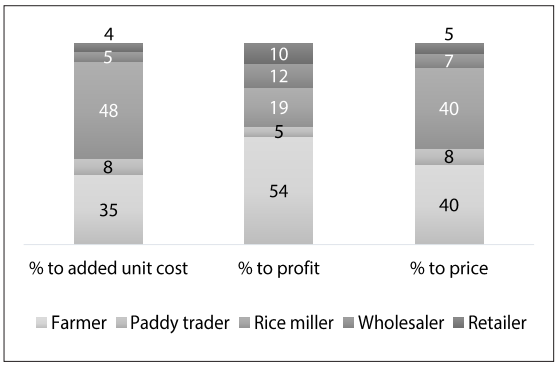
Table 9. Value addition and relative financial position of value chain actors in the rice chain

VC Actor	Product	Cost			Profit			Margin	
		Total Unit Cost (PHP/kg)	Added Unit Cost (PHP/kg)	% to Added Unit Cost	Selling Price (PHP/kg)	Unit Profit (PHP/kg)	% to Profit	Unit Margin (PHP/kg)	% to Price
Farmer	Fresh paddy	10.65	10.65	35	16.31	5.66	54	16.31	40
Paddy trader	Dry paddy	18.86	2.55	8	19.37	0.51	5	3.06	8
Rice miller	Well milled rice	33.89	14.52	48	35.86	1.97	19	16.49	40
Wholesaler	Well milled rice	37.27	1.41	5	38.51	1.24	12	2.65	7
Retailer	Well milled rice	39.68	1.17	4	**40.75**	1.07	10	2.24	5
Total			**30.30**	**100**		**10.45**	**100**	**40.75**	**100**

22 to 14 percent MC valued at PHP 1.67/kg and marketing cost of PHP 0.88/kg. Rice millers, the next stage in the chain, spent an added cost of PHP 14.52/kg for carrying out the processing of paddy into milled rice and handling, packing, storing, and distributing milled rice to wholesaler. The added cost consists of transforming dry paddy into milled (at 63.88% MR, 1.57 kg of dry paddy to recover 1 kg of milled rice) valued at PHP 10.95/kg and marketing cost of PHP 3.57/kg. From the procurement cost of dry paddy (PHP 19.37/kg) and an added cost (PHP 14.52/kg), millers spent PHP 33.89/kg in total and gained PHP 1.97/kg for selling the milled rice at a wholesale price of PHP 35.86/kg. The next stage in the chain is the rice wholesalers whose main function is marketing or distributing of milled rice to retailers. In carrying out this function, they spent an added cost of PHP 1.41/kg owing to marketing cost and got PHP 1.24/kg of unit profit. Retailers, the last actors in the chain, incurred the smallest added cost amounting to PHP 1.17/kg due to marketing cost. They received a net profit of PHP 1.07/kg for performing the retailing function.

Overall, the total value addition or the unit price of milled rice at the retail level is equal to PHP 40.75/kg, which consists of the total added costs incurred (PHP 30.30/kg), and the total profits (PHP 10.45/kg) earned by all the chain actors. Total added costs incurred comprise 74 percent of the unit price. From Figure 5, the largest added cost was incurred by millers at 48 percent (PHP 14.52/kg) of the total added cost,

Figure 5. Relative financial position of VC actors for milled rice



comprised of processing paddy into milled rice and marketing cost. Farmers incurred the second biggest added unit cost (35%) from high cost of producing paddy and from low yield. Paddy traders had a share of 8 percent of the total added cost attributed to shrinkage losses and marketing cost. For wholesalers and retailers, they had a share of 5 percent and 4 percent of the total added unit cost, respectively, wherein administrative cost, transportation/shipping, and working capital are the biggest cost components. Similarly, farmers and millers obtained the major shares of the margin, 40 percent each of the unit price of rice due mainly to the high cost of producing paddy and high paddy price and low MR, respectively, which resulted in high unit price of rice (Table 9). Paddy traders, wholesalers, and retailers had the smallest shares at 8 percent, 7 percent, and 5 percent, respectively.

The total profits (PHP 10.45/kg) earned by the chain players represent around 26 percent of the unit retail price. Farmers received the largest profit share at 54 percent (PHP 5.66/kg) of the total chain's profit, while the remaining 46 percent of the profit is shared among other chain actors (Figure 5). While farmers receive the biggest profit share on a per kilogram basis, they only produced paddy of about 8 t/year and only 70 percent was marketable surplus. Profit turnover was also very slow, realized from 4–6 month cropping period, and subjected to the risk of price fluctuation. Profit shares of millers and other VC actors were relatively small in unit terms, but their total profits are multiplied through volume handled, fast turnover of stocks, integration of functions, and investment on quality improvement.

Constraints in the Rice Value Chain by Segment

Based on the analysis by segment, the large value additions in the RVC in the Philippines were primarily attributed to the high paddy prices and high marketing costs. The high price of paddy is due to high costs of production, particularly cost of labor, which accounted for almost 50 percent of the costs. Production costs in the Philippines were relatively higher than in Thailand and Vietnam by PHP 4–6 per kg (Bordey et al. 2016). Similarly, marketing costs were substantially greater in the country than in Thailand (Dawe et al. 2008; Beltran et al. 2016) and Vietnam (Beltran et al. 2016). High marketing costs in the Philippines are brought about by lower economies of scale and underutilized rice mills, high costs of transport and packing, and high paddy prices that increase the cost of working capital. Moreover, the presence of many profit-seeking players involved in the chain has also contributed to higher unit margin of rice. All these inefficiencies resulted in high price of rice in the domestic market and low competitiveness of the rice sector in general. Table 10 lists constraints and opportunities identified by segment that affect the performance of key players in the rice VC and the rice industry in general.

Table 10. Constraints and opportunities per segment in the rice value chain

Constraints	Opportunities
Production	
Low paddy yield	• Free quality seed from Rice Competitiveness Enhancement Fund (RCEF) program
High production cost due to high cost and shortage of labor and high price of material inputs (seeds, fertilizer, pesticides, and diesel)	• Availability of machinery from RCEF mechanization program (i.e., combine harvester) and technologies (direct seeding) that could cut labor costs.
Inadequate water supply	• Availability of funds from the government for the construction of irrigation facilities and rehabilitation of dysfunctional facilities. • The government through the Bureau of Soils and Water Management has also embarked on small-scale irrigation projects such as small water-impounding projects, small diversion dams, shallow tube wells, and small farm reservoir. • Availability of water-saving technologies such as alternate wetting and drying (AWD).
Climate change, which results in high production losses	• Availability of climate-smart technologies and practices such as diversified farming, cultivation of varieties adapted to various ecosystems and stresses, controlled irrigation, and use of machines that consume renewable energy.
Limited drying and storage facilities resulting in low quality and low price for fresh paddy	• The Department of Agriculture (DA) through RCEF mechanization program and National Rice Program (NRP) provided mechanical dryers and multipurpose drying pavements to farmers' associations and cooperatives (FACs)

Continued on next page

Table 10 continued

Constraints	Opportunities
Mismatch of available high-quality variety with farmers' preference	• DA regional field offices and LGUs facilitate in making preferred good-quality seeds accessible to farmers. • Presence of community seed banks, which is considered an extension tool to increase farmers' access to high quality seeds.
Pest and disease incidence	• Availability of pest-and disease-resistant varieties, and good farming practices such as Integrated Pest Management organic pesticides (bio-control agents)
Low adoption of new crop management technologies	• Presence of LGUs who are responsible for extension services to promote available packages/set of rice technologies and practices. • Presence of information portals such as the *Pinoy* Rice Knowledge Bank, PhilRice Text Center, and Farmers' Contact Center
Low access to low cost credit and crop insurance	• Presence of agricultural credit and financing programs of the DA through the Agricultural Credit and Policy Council (ACPC) to help farmers access timely and adequate credit with affordable interest rates. • Availability of low-cost credit from RCEF credit program
Unstable price specifically for fresh paddy resulting in low rice farm income	• Some LGUs and FACs are buying fresh *palay* to stabilize paddy price
Aggregation	
Low quality and high price of paddy; many varieties – lead to misclassification	• Available information on the recommended varieties, together with their agronomic traits, grain quality features, and resistance to pests and diseases
Limited access to modern storage and mechanical drying facilities; thus, depend mostly on sun drying that reduce the quality of paddy	• DA provides mechanical drying facilities to FACs that are engaged in paddy consolidation
High transportation expenses due to high price of diesel, labor, and maintenance cost	• DA through its regional field offices, Department of Public Works and Highways, and LGUs is implementing the Farm-to-Market Road Development Program (FMRDP), which aims to construct, restore and rehabilitate rural roads; reduce transportation cost of farm inputs and outputs as well as minimize postharvest losses; improve access to basic services; and connect farms/coastal areas to main roads to promote agri-tourism.
Limited knowledge on paddy grades and standards set by NFA and Bureau of Agriculture and Fishery Standard; and limited advocacy for disseminating these to new traders	• DA has recently approved the Philippine National Standard (PNS) for grains grading classification of paddy and milled rice. It covers the quality and safety standards, along with prescribed packaging materials, labeling, and price tags that may be observed in the market.
• Non-transparency in quality assessment of paddy due to limited moisture meter machine • High handling cost as it is manually done from procurement to disposal of paddy	• DA and the Philippine Center for Postharvest Development and Mechanization (PHilMech) provide moisture meters to FACs
Limited procurement fund	• Availability of small and medium enterprise (SME) credit facility from Land Bank of the Philippines, which support "agripreneurs" in starting or expanding their business operations.
Processing	
Tight paddy supply and influx of imported rice, which resulted in underutilization of rice mills	• Presence of institutions such as the Philippine Rice Research Institute or PhilRice, PHilMech, and state universities and colleges that are responsible for rice research and development of yield-enhancing and cost-reducing technologies and practices to increase yield and reduce cost.

Continued on next page

Table 10 continued

Constraints	Opportunities
Low quality of many rice varieties and high procurement cost of paddy	• Availability of postharvest facilities and cost reducing technologies
Insufficient modern milling, mechanical drying, weighing and storage facilities, which result in low quality milled rice and high marketing cost; many mills have low milling capacities (2–5t/hr) and milling recovery	• Proper drying and storage of paddy improve grain quality and milling efficiency. • NFA reported 188 modern rice mills in 2013 and 5 rice processing centers (RPCs) from the Korea International Cooperation Agency or KOICA with large milling capacities
High cost of electricity and diesel also contributes to high milling and mechanical drying costs	• Availability of rice mills that generate rice husks that can be used for power generation.
Limited access to post-harvest and market facilities of small farm cooperatives engaging in processing	• PHilMech awarded several units of Rice Processing Centers (RPCs) to some FACs
High capital requirements	• Presence of agricultural credit and financing programs of the DA and Land Bank of the Philippines to help FACs and entrepreneurs access timely and adequate credit with affordable interest rates.
Marketing	
High procurement price and low quality of milled rice	• Availability of drying and storage facilities for proper drying and storage of paddy improve grain quality and milling efficiency.
High transportation/shipping cost and interisland freight for rice	• The implementation of RA 10668, known as the Cabotage Law increase the competition among shipping companies. This will lead to lower the cost of shipping of domestic and international goods.
• Congested port during peak season leads to inefficiency • High administrative costs	• Availability of government funds that will be used for the construction of new port facilities and renovation of new ones to provide quality services of the Ro-Ro ships for cargo and passengers in the Visayas and Mindanao

CONCLUSION AND RECOMMENDATIONS

The high domestic price of rice in the country was mostly attributed to relatively low yields, high production and marketing costs, involvement of many players, and limited investments in enabling infrastructure and market support such as transport, handling, storage, drying, and milling facilities. These affected the performance of the entire RVC. With the replacement of QRs by an import tariff, there is a need to identify a set of innovative actions and investments to improve the competitiveness of the rice sector that can make it more responsive to emerging market/trade opportunities, globally competitive, and more sustainable. The following upgrading strategies and specific interventions may be suggested to improve the competitiveness of the Philippine rice industry, in general, and of specific segments of the VC, in particular:

1. Improve yields through the use of high-quality varieties and reduce postharvest losses to increase and sustain the volume of quality rice supply.
2. Reduce cost of production by promoting labor-saving, cost-reducing, and climate-smart technologies and practices to lower the per-unit cost of paddy and consequently the price of milled rice.
3. Reduce marketing cost or margin through better logistics, support of mechanization of processing and marketing facilities, improvement of rice quality, and increased competition.
4. Strengthen training and extension delivery services to accelerate the delivery of the latest production, postharvest, and processing technologies to farmers and other VC actors.

5. Provide economic incentives and ensure enabling environments such as appropriate production support, intensive NFA paddy procurement in major rice-producing and remote surplus provinces given adequate budget allocation, greater access to low-cost credit, and expansion of affordable crop insurance to farmers.
6. Enhance the income share of farmers through greater involvement of farmers' associations or cooperatives in the various value-adding functions in the rice value chain.
7. Properly manage the rice supply and demand situation to stabilize paddy and rice prices.
8. Increase income opportunities of farmers and other VC actors by embarking on product development of rice and by-products, and value adding activities for agribusiness opportunities.

In addition, listed below are the specific interventions recommended at the stakeholders' workshop for upgrading of segments of the value chain.

Segment	Specific Intervention
Production	• Improve rice yield by promoting yield increasing technologies and practices such as increase use of high quality inbred & hybrid seeds; and ensure wider adoption of *Palay*Check and Rice Crop Manager. • Mechanize labor intensive farm operation: land preparation, transplanting, and harvesting and threshing by using appropriate farm machine to reduce labor use and cost. • Increase public investment in irrigation prioritizing small-scale irrigation project. • Enhance access to and increase adoption of appropriate postharvest facilities such as solar and mechanical dryers, and storage by establishing and improving machine custom service center in areas with low access. • Subsidize price of seeds and fertilizers, and exempt rice from excise tax on diesel and oil to lower input cost. • Equip farmers with skills to pursue off-farm livelihoods and increase their "agripreneurial" skill and help them link with market to increase income.
Aggregation	• Establish grain trading posts equipped with complete postharvest and market facilities under Public-Private Partnership, which will provide custom service to farmers, farmers' groups, and other VC actors prioritizing major surplus provinces to improve cost efficiency. • Encourage farmers' groups and traders to lessen dependence on customary solar drying method that result in high drying losses. • Conduct competency-based training of farmers, farmers' cooperatives/ associations on proper operation and maintenance of postharvest and processing technologies. • Carry out regular training on PNS-BAFPS grain quality grades and standards for farmers' cooperatives and other VC actors. • Intensify strict monitoring of traders' grain classification and weighing practices.
Processing	Reduce handling, milling, and marketing cost through better logistics, infrastructure, and market support through: • upgraded existing rice mills, storage, and dryer facilities to increase quality of rice and reduce cost; • mechanized handling of product, by using conveyor belts of moving *palay* or milled rice; • promotion of the use of solar panels and establish of rice-husk powered plant to reduce dependence on electricity to lessen milling cost; • upgraded rice processing center (RPC) provided to farmers' group to improve milling efficiency and quality of rice; • improved quality of paddy to achieve higher milling recovery through breeding of varieties with high head rice recovery; and • linking VC actors to finance service providers to invest in postharvest technology for integrated postharvest operations.

Continued on next page

Continued from previous page

Segment	Specific Intervention
Marketing	• Improve the density and quality of roads in major production areas and market centers to accommodate trucks with large capacity. • Improve inter-island water transport facilities such as the *ro-ro* (roll-on/roll-off) nautical highway and port facilities. • Encourage investments for the upgrading of port facilities to enable use of foreign vessels in grain transport to reduce freight cost. • Other complementary interventions such as strengthen the implementation of grain grading and pricing standards to ensure quality; and regulate the volume of imported rice especially during peak harvest months.

REFERENCES

Arida, I.A., J.C. Beltran, R.Z. Relado, et al. 2016. "Socioeconomic Impact of Adopting Rice Combine Harvester in the Philippines." *National Rice R&D Highlights.* Science City of Muňoz (Philippines): Philippine Rice Research Institute, 12–17.

Asian Partnership for the Development of Human Resources in Rural Asia (AsiaDHRRA). 2008. *Value Chain Analysis Report: Cambodia, Philippines, Vietnam*. AsiaDHRRA and the ASEAN Foundation. Manila, Philippines.

Beltran, J.C, F.H. Bordey, P.F. Moya, et al. 2016. "Rice Prices and Marketing Margins." In F.H. Bordey, P.F. Moya, J.C. Beltran, and D.C. Dawe (eds.), *Competitiveness of Philippine Rice in Asia*. Science City of Muñoz (Philippines): Philippine Rice Research Institute and Manila (Philippines): International Rice Research Institute, 55–73.

Bordey, F.H., P.F. Moya, J.C. Beltran, D.C. Dawe (eds). 2016. *Competitiveness of Philippine Rice in Asia*. Science City of Muñoz (Philippines): Philippine Rice Research Institute and Manila (Philippines): International Rice Research Institute.

Briones, R.M., and L.A.C. Tolin. 2016. "Warehouse Receipts as a System for Improving the Efficiency of Rice and Corn Marketing in the Philippines." *Discussion Paper Series* No. 2016–45. Manila: Philippine Institute for Development Studies.

Dawe, D.C., P.F. Moya, C.B. Casiwan, and J.M. Cabling. 2008."Rice Marketing Systems in the Philippines and Thailand: Do Large Numbers of Competitive Traders Ensure Good Performance?" *Food Policy* 33: 455–463.

Intal, P.S., and M. Garcia. 2005. "Rice and Philippine Politics." *Discussion Paper Series* No. 2005–13. Makati City: Philippine Institute of Development Studies.

Juliano, B.O., and P.A. Hicks. 1996. "Rice Functional Properties and Rice Food Products." *Food Reviews International* 12(1): 71–103.

Mataia, A.B., N. Jamora, P. Moya, S. Francisco, and D. Dawe. 2011. "Sources of Decade Rice Yield Growth in the Philippines." *Philippine Journal of Crop Science* 36(2): 50–55.

NFA (National Food Authority). 2015. "National Food Authority Corporate Profile as of June 30, 2015."

PSA (Philippine Statistics Authority). 2015. "CountrySTAT Philippines" Accessed 20 May 2015, http://countrystat.psa.gov.ph/

_____. 2017. "CountrySTAT Philippines." Accessed 15 June 2017, http://countrystat.psa.gov.ph/

Salvador, A., D. Miranda, V.E. Camaso, R. Gutierez, and R. Paz. 2012. "Assessment of the State and Magnitude of the Paddy Grains Postproduction Losses in Major Rice Production Areas." *PhilMech Journal* (2)1: 19–37.

Yorobe, J.M., J.C. Beltran, A.B. Mataia, G.C. Cataquiz, and M.M. Elauria. 2005. "Rice Marketing in the Philippines: Performance and Policy Implications." Draft final report submitted to the Philippine Rice Research Institute (PhilRice), Science City of Muñoz, Nueva Ecija, Philippines. Unpublished.