SOCIOECONOMIC & TECHNOLOGICAL PROFILE OF A SEMI-MECHANIZED RICE PRODUCTION SYSTEM:

THE CASE OF WEST JAVA, INDONESIA

Aileen C. Litonjua , Putu Wardana, Suennie Jane C. Paran,
Ma. Shiela D. Valencia, Francia M. Macalintal,
Flordeliza H. Bordey, and Piedad Moya

The responsibility for this publication rests with the the Philippine Rice Research Institute and the International Rice Research Institute.

SUGGESTED CITATION

Litonjua AC, Wardana P, Paran SJC, Valencia MSD, Macalintal FM, Bordey FH, Moya PF. 2015. Socioeconomic and Technological Profile of a Semi-Mechanized Rice Production System: The Case of West Java, Indonesia. Science City of Muñoz, Nueva Ecija (Philippines): Philippine Rice Research Institute, and Los Baños (Philippines): International Rice Research Institute . 25 p.

Published by:
Philippine Rice Research Institute
Maligaya, Science City of Muñoz, Nueva Ecija

SOCIOECONOMIC & TECHNOLOGICAL PROFILE OF A SEMI-MECHANIZED RICE PRODUCTION SYSTEM:
THE CASE OF WEST JAVA, INDONESIA

Aileen C. Litonjua
Putu Wardana
Suennie Jane C. Paran
Ma. Shiela D. Valencia
Francia M. Macalintal
Flordeliza H. Bordey
and Piedad Moya

The Philippine Rice Research Institute (PhilRice) is a chartered government corporate entity under the Department of Agriculture. It was created through Executive Order 1061 on November 5, 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologies so farmers can produce enough rice for all Filipinos.

It accomplishes this mission through research, development, and extension work in its central and seven branch stations, coordinating with a network that includes 57 agencies and 70 seed centers strategically located nationwide.

PhilRice has the following certifications: ISO 9001 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

Mailing address: Maligaya, Science City of Muñoz, 3119, Nueva Ecija
Phone: +63 (44) 456-0433, 456-0258, 456-0277
Fax: +63 (44) 456-0651 loc 203
E-mail: prri@philrice.gov.ph
Home page: www.philrice.gov.ph

The International Rice Research Institute (IRRI) is the world's premier research organization dedicated to reducing poverty and hunger through rice science; improving the health and welfare of rice farmers and consumers; and protecting the rice-growing environment for future generations. IRRI is an independent, nonprofit, research and educational institute, founded in 1960 by the Ford and Rockefeller foundations with support from the Philippine government. The institute, headquartered in Los Baños, Philippines, has offices in 17 rice-growing countries in Asia and Africa, and more than 1,000 staff members.

Working with in-country partners, IRRI develops advanced rice varieties that yield more grain and better withstand pests and disease as well as flooding, drought, and other harmful effects of climate change. More than half of the rice area in Asia is planted to IRRI-bred varieties or their progenies. The institute develops new and improved methods and technologies that enable farmers to manage their farms profitably and sustainably, and recommends rice varieties and agricultural practices suitable to particular farm conditions as well as consumer preferences. IRRI assists national agricultural research and extension systems in formulating and implementing country rice sector strategies.

Mailing address: DAPO Box 7777, Metro Manila, Philippines
Phone: +63 (2) 580-5600
Fax: +63 (2) 580-5699
E-mail: info@irri.org
Web: irri.org

CONTENTS

TABLES

FIGURES

ABBREVIATIONS

d - day
ha - hectare
kg - kilogram
km - kilometer
L - liter
md - manday
mm - millimeter
t - ton
US$ - United States dollar
yr - year

PREFACE

In 1995, the International Rice Research Institute coordinated an international effort that looked into the causes of declining productivity trends in intensive irrigated rice systems in the Philippines, China, Indonesia, Thailand, Vietnam and India. A major feature of this study is the development of a database on input use, level of rice output, prices and detailed cost of rice production. In this study, the costs of producing rice in Central Luzon, Philippines were compared with those in Central Plain, Thailand; Mekong Delta, Vietnam; West Java, Indonesia; Tamil Nadu, India; and Zhejiang, China. More than a decade has passed since then, and new government policies, as well as trade regimes, may have caused changes in relative prices. A cost structure of paddy production that is comparable across countries is in short supply. Thus, it is imperative to update the findings of the study.

Rice is intricately related to food security and international trade policies in major rice producing countries. As a result, the Philippine Rice Research Institute of the Department of Agriculture and the International Rice Research Institute, with the participation of the Philippine Council for Agriculture and Fisheries also of the Department of Agriculture jointly planned, designed and implemented a project entitled "Benchmarking the Philippine Rice Economy Relative to Major Rice–Producing Countries in Asia". The Philippine government, through the Department of Agriculture, provided the full financial support for this undertaking.

The country monograph is one of the major outputs of this project. This monograph is intended for a general audience who would like to learn about the current status of rice production in Asian countries. It attempts to provide the most detailed information on rice farming in intensively cultivated irrigated rice areas of the major rice-producing countries in Asia. These countries include Indonesia, Philippines, Thailand, Vietnam, India and China. All of these countries are among the top 10 rice producers in the world. Data from each country were collected through interviews using electronic questionnaires, which included questions on paddy output, input use, cost of rice production for crop year 2013-14, as well as basic farm and household characteristics.

Each monograph contains a detailed description of each country's crop management practices, input use, labor using and labor-saving practices and various support and services provided by their government to enhance rice production. Given the impending implementation of the free trade agreement which is expected to increase the flow of rice trade among Asian rice bowls, these studies also evaluated the costs and profitability of producing paddy rice.

Results from this study can provide insights on how a country can further improve its competitiveness in rice production and marketing. We gain a perspective on the policies being implemented by our neighbors to make their respective rice industry competitive. By understanding the costs of producing and marketing rice amidst different government policy frameworks in major rice-producing countries, agricultural policymakers can make appropriate decisions on how to best position the country's interest in terms of rice food security. Policymakers and planners can use this information in crafting sustainable development programs for the rice industry.

Project Leaders

Flordeliza H. Bordey

Piedad F. Moya

ACKNOWLEDGMENT

We would like to acknowledge the many individuals who have made the completion of these country studies possible.

We would like to express appreciation to the DA National Rice Program led by Assistant Secretary Edilberto M. De Luna and to the DA-Bureau of Agricultural Research headed by Dir. Nicomedes M. Eleazar for funding the project.

We highly recognize the support and encouragement provided by Dir. Edmund J. Sana of the DA National Rice Program and Dr. Eufemio T. Rasco, former executive director of PhilRice, without whose insistence and institutional support, this project will not materialize.

Also, recognition is due Dr. Samarendu Mohanty, head of IRRI's Social Science Division, who gave full support by allowing some of his research and administrative staff to participate in this project. We also appreciate the manpower support provided by the Philippine Council for Agriculture and Fisheries under the leadership of Engr. Ariel T. Cayanan.

We are also grateful to Dr. Bruce Tolentino, IRRI deputy director general, for inspiring us to work harder to complete this important project.

We are deeply indebted to Dr. David Dawe of FAO who patiently did the technical edit of all of the country monographs. He has provided guidance since the beginning from the conceptualization, data collection, and analysis of the data to produce these monographs.

We would also like to thank the highly dedicated staff of IRRI, PhilRice, and DA BAR who helped us in administrative matters and coordination work to implement this project.

We are also thankful to our country collaborators who helped facilitate our field work in each study site.

Lastly, we would like to thank all the rice farmers in the various sites who willingly provided all the information that we needed to complete these studies.

ABSTRACT

This paper updates information on rice farming in intensively cultivated and irrigated areas in West Java, Indonesia. Specifically, the project aims to describe farmers' socioeconomic characteristics; assess current yield and quantity of inputs used; analyze costs incurred and income earned from rice farming; determine farmers' technology adoption pattern; determine government support available to farmers; and recommend strategies that can further improve farmers' production and income. Results show that rice farming in West Java has improved in terms of yield, which can be attributed to low seeding and high fertilizer rates. Partial productivity of nitrogen stagnated in the area, while that of labor improved. Despite this, rice farming in West Java remains labor-intensive and less mechanized, leading to high labor cost. While cost and return analysis shows the profitability of rice farming in the area, farmers could earn more if labor cost is reduced through mechanization and better labor payment arrangement.

Keywords: West Java, fertilizer subsidy, mechanization, low seeding rate

INTRODUCTION

Rice is considered the most important crop in Indonesia, planted in 13.8 million ha of the country's agricultural land in 2013. In the same year, Indonesia produced 71.2 million t. With its vast rice land and high volume of production, the country places third among the world's major rice producers (Fig. 1). However, in the last 5 years, the country's seventh rank as a major rice importer has remained. On average, the country requires 1.1 million t of imports annually (USDA, 2012), reflecting the importance of rice in the Indonesian diet. It is the major caloric source of more than 250 million Indonesians (2014). Indonesia is number seven in terms of high per capita rice consumption—as much as 139 kg annually per person (USDA, 2012). Furthermore, population grows at the rate of 1.3% annually (USDA, 2012).

Indonesia is an archipelago of 17,500 islands located along the equator, which houses five of the world's largest islands, namely, Sumatra, Kalimantan, Papua, Sulawesi, and Java (Fig. 2). Rice production is heavily concentrated in South Sumatra, West Java, Central Java, East Java, and South Sulawesi.

Rice is cultivated under three ecosystems: 1) *sawah* or wet cultivation, 2) *padi gogo* or upland dry cultivation, and 3) *lading* or shifting fire farming. Padi gogo is typically rainfed while lading is prevalent in the outer islands. Sawah often makes use of an extensive irrigation system and is mostly found in lowland areas, particularly in Java, Sumatra, and Sulawesi. It accounts for approximately 90% of total national rice area and 94% of total production.

In spite of the importance of the irrigated ecosystem in providing the bulk of national production, the sustainability of this production system has been of great concern over the years. There are evidences of stagnating productivity and diminishing soil fertility in many of Asia's intensively cultivated and irrigated rice areas (Cassman and Pingali, 1995; Ali, 1996; Huang and Rozelle, 1995). Because of this, the International Rice Research Institute (IRRI) conducted the study "Reversing the Trends of Declining Productivity" (RTDP) from 1994 to 1999. It assessed trends in productivity of intensively cultivated irrigated farms of selected rice producing countries in Asia, including Indonesia. Fifteen years after, there was a recognized need to update the information derived from RTDP as significant developments in the rice farming sector, particularly in Indonesia, could have occurred over the years. The new data would serve as a reference material in generating need-based rice research and policymaking. This paper contributes in this respect.

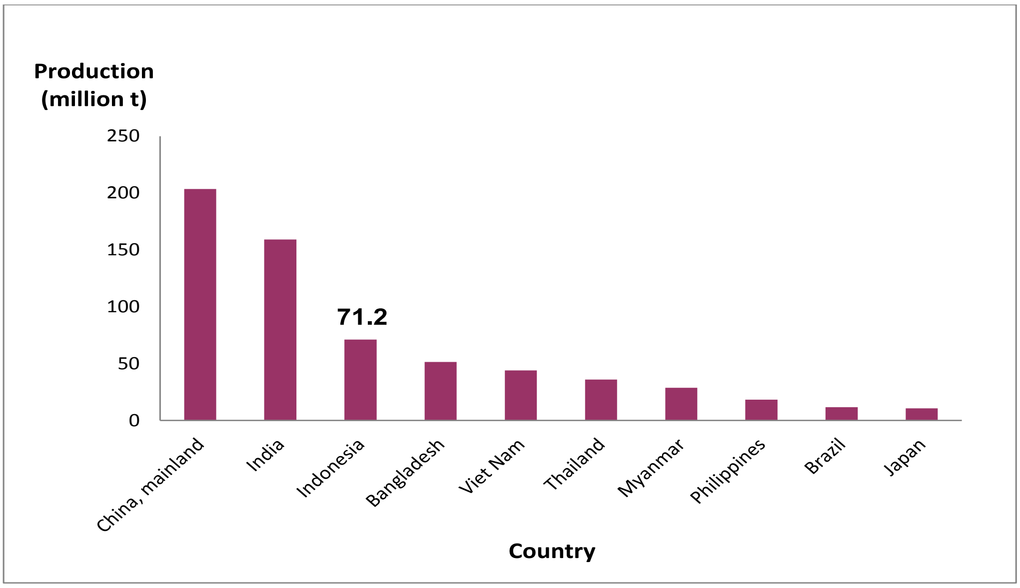

Fig. 1. Total production of the top 10 rice-producing countries in the world, 2013 (Source: FAOSTAT, 2013).

Fig. 2. Map of Indonesia (Source: www.dive_the_world.com).

Specifically, this paper describes the socioeconomic and demographic characteristics of farmer-respondents in selected irrigated areas of Indonesia. It likewise determines yield and quantity of inputs used in the survey areas. Additionally, technology usage and farm practices have been identified and the cost and profitability of rice farming also examined. Government support provided to farmers in this production ecosystem is also identified. Together, these information were used to outline rice farming's best practices in irrigated areas so that other rice-producing nations may benefit from this valuable knowledge.

METHODOLOGY

Data sources and methods

West Java was previously selected by the RTDP to represent the intensively cultivated and irrigated rice areas in Indonesia. It is the second largest rice-producing province in the country. It contributed 11.58 million t, 16% of the country's total paddy rice production, in 2014 (Fig. 3). In the same year, the province has 1.98 million ha of irrigated area harvested with an average yield of 5.9 t ha^{-1} (BPS, 2015). As a major rice-producer, West Java is home to some of the best farmers in the country. Keeping stakeholders updated about this important rice farming subsector can help in the development of appropriate policies to further advance the Indonesian farmers' welfare.

West Java is located in the western part of Java Island. Agriculture dominates the economy and cultivated lands are extensively irrigated and double-cropped. Climate in the region is basically tropical, with mean annual temperature between 22 and 29^{o}C. It receives 4,000 mm rainfall annually. In general, rice is commonly grown in two cropping seasons, the dry and wet seasons. The first crop is grown in the dry season (DS), which starts in April and ends in July or August, whereas the second crop is grown in the wet season (WS), from October to February. Therefore, paddy rice harvested within the first semester is considered their WS harvest; while that harvested within the second semester is the DS harvest.

The project team gathered farm-level data through surveys. Subang regency in West Java province was selected as the survey site because it is one of the intensively cultivated and irrigated rice areas in the province. Specifically, the survey was conducted in the villages of (1) Karanghegar and (2) Pringkasap in Pabuaran subdistrict, (3) Sukareja and (4) Sukasari in Pamanukan subdistrict, and (5) Bojongjaya and (6) Bojongtengah in Pusakajaya subdistrict. The team prioritized interviews of RTDP farmers. However, majority of them were unavailable during the survey and were thus replaced by farmers who met the following criteria: (1) those living in the same village, (2) have at least 10 years of farming experience, (3) have an irrigated rice farm, and (4) have standing crops in 2013. Additional farmers were also interviewed to complete the target sample size of 100 using the same criteria. The coordinating village officers were the ones who chose the qualified replacement and additional farmers.

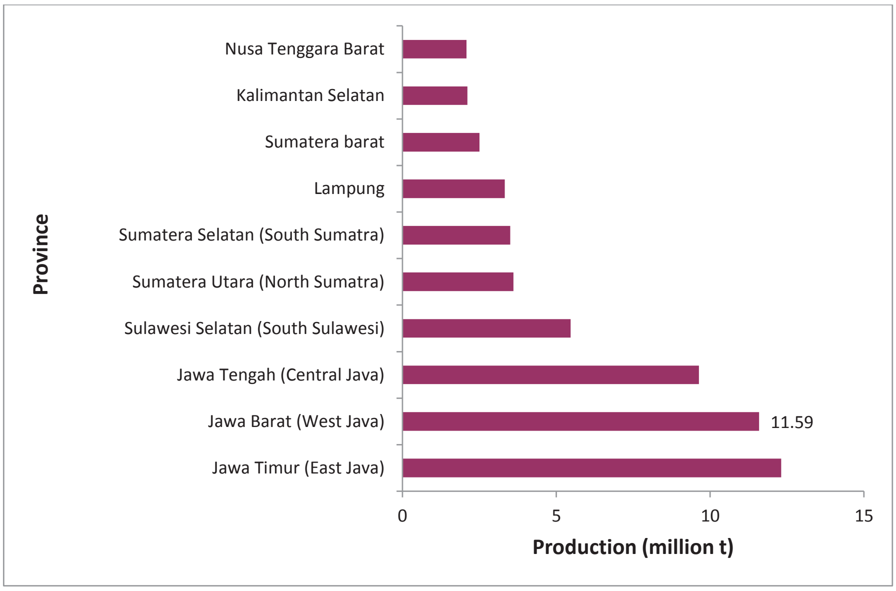

Fig.3. Total production of the top 10 rice-producing provinces of Indonesia, 2014 (BPS, 2015).

The survey covered the January-June 2013 (WS) and the July-December 2013 (DS) cropping periods. For WS, 100 farmers were interviewed. The same farmers were interviewed during the second visit covering the DS cropping, except for four farmers who were replaced because they were unavailable at the time.

The gathered data were on sociodemographic characteristics, yield, input use, prices of inputs and outputs, costs incurred and income earned by farmers. The data were analyzed using descriptive statistics, cost and return analysis, and partial factor productivity estimates. The test of two means was used to determine whether results from the two seasons are statistically different from each other.

Data Limitation

The data gathered in the surveys were based on farmers' recall. Hence, accuracy depends on their ability to remember details of rice production. Additionally, interviews were done with the assistance of translators/interpreters. Accuracy of the data, then, also depends on how well the translators were able to capture the farmers' reported information. Lastly, the survey was done for intensively cultivated and irrigated rice areas. Results may not reflect conditions in other farm ecosystems that could also have significant rice production. Despite these drawbacks, the dataset remains the most detailed and updated data on rice production in West Java, Indonesia.

Data gathering through personal interview guided by a structured questionnaire and aided by translator.

RESULTS & DISCUSSION

Farm and household characteristics

Results of the survey show that farmers cultivated an average of two rice parcels. The average size of the largest parcel was 1 ha; the farm was located at a distance of 3.9 km, on average, from the nearest market. Most of the farmers (46%) reported that farm-to-market roads were mostly asphalt (Table 1). (The usual unit of land used in the province is *bau* and *bata.* One hectare is equivalent to 700 bata and 1.4 bau.)

Table 1. Selected farm characteristics and farm assets of farmer-respondents, West Java, Indonesia, 2013.

Farm characteristic	Value/Percent (n=100)
Average number of parcels (cultivated to rice)	1.9
Average area of largest parcel (ha)	1.0
Distance to market (km)	3.9
Road structure (% farmers reporting)	
Asphalt	46
Sand and gravel	23
Dirt road	17
Farm assets (% farmers reporting)	
Sprayer	96
Motorcycle	55
Fumigation tube	47
Irrigation water pump	46
Weighing scale	40

Farmer-respondents owned some farm assets used in rice farming. These were manual sprayers (96%), motorcycles (55%), fumigation tubes for rats (47%), irrigation water pumps (46%), and weighing scales (40%) (Table 1).

All sample farmers were male. In West Java, male farmers are more dominant and visible in the fields. Women are involved only in some field activities such as harvesting and threshing because most of the time they do household chores. The sample farmers, generally in their fifties, have been farming for an average of 26 years. Household size was four. In terms of education, the sample farmers have had 7 years of schooling. They can read, write, and communicate well with researchers and agricultural extension workers. Majority of them were landowners (88%), and members

Table 2. Sociological profile of farmer-respondents, West Java, Indonesia, 2013.

Characteristic	Value/Percent (n=100)
Age (yr)	51
Education (yr)	7
Household Size (no. of persons)	4
Sex (% male)	100
Farming experience (yr)	26
Tenure (% owner)	88
Organization (% member)	75
Training (% trained)	50

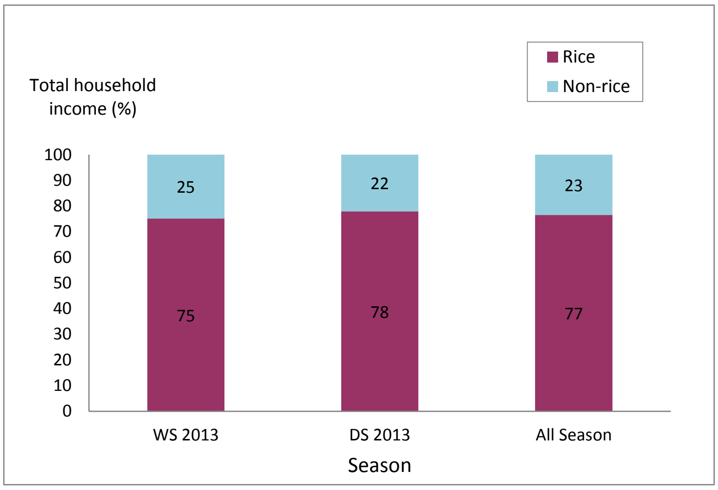

Fig. 4. Percentage distribution of household income, by source, West Java, Indonesia, 2013.

Table 3. Top three varieties used by farmer-respondents, West Java, Indonesia, 2013.

Jan-Jun (n=100)		Jul-Dec (n=100)	
Variety	% farmers	Variety	% farmers
Ciherang	41	Ciherang	48
IR42	31	IR42	24
Sidenok	9	Gebrug	4

of farmers' organizations (75%). Fifty percent of the respondents had attended rice production-related training within the 2008-13 period (Table 2).

In 2013, the average total annual household income of farmers amounted to US$13,396.50. Seventy-seven percent of this was rice-based income (Fig. 4). This implies that rice farming is the main livelihood of the sample rice farming households.

Input use

Seeds

The top three popular varieties used by farmers in January-June 2013 were Ciherang (41%), IR42 (31%), and Sidenok (9%). In July-December 2013, most farmers planted the same varieties Ciherang (48%) and IR42 (24%), but others shifted to Gebrug (4%) instead of Sidenok (Table 3). Moreover, the adoption rate of tagged seeds (i.e., high-quality seeds), was 54% in WS, which further increased to 60% in the DS.

The average seeding rate of farmers in the WS was 20 kg ha^{-1}, which significantly increased to 23 kg ha^{-1} in the DS (Table 4). This is because farmers replanted more in the DS than in the WS. Farmers managed to implement low seeding as majority of them adopted transplanting of 1-3 seedlings $hill^{-1}$ and also straight-row planting methods called *legowo* and *tegel*. Legowo is a rice planting system that uses four to six hills per row with a usual planting space of 20 cm x 10 cm. Farmers skip the next hill and continue to transplant on the next four to six hills. On the other hand, tegel uses the same layout but has square spacing with a planting distance of 20 cm x 20 cm. Hidayah (2013) mentions that legowo is being adopted because it can (1) lead to higher yield, especially for the border plants, (2) allow easier pest, disease, and weed control, (3) allow better water management, and (4) lead to efficient use of fertilizer. The average age of seedlings at transplanting was 23 d in WS and 24 d in DS (Table 4).

Table 4. Seed types and other farming practices adopted by respondents, West Java, Indonesia, 2013.

Technology	Value/Percent	
	Jan-Jun (n=100)	Jul-Dec (n=100)
Seed (% of farmers)		
Tagged seed	55	60
Farmers seed [a]	45	40
Transplanted (% of farmers)	100	100
Age of seedlings (d after sowing)	23	24
Seeding rate (kg ha^{-1})	20	23*

[a] Farmers' seed include farmers' saved seed and good seed.
*Significant at 95% confidence level.

A rice field that uses legowo or tegel system.

Fertilizer

Fertilizer use

Most farmer-respondents used urea (46-0-0), compound fertilizer (NPK), and superphosphate-36 (SP-36) to fertilize their plants in both seasons (Table 5). For specific nutrient components, farmers were able to supply 141-148 kg N ha^{-1}, 76-84 kg P_2O_5 ha^{-1} (33-37 kg/ha), and 41-43 kg K_2O ha^{-1} (34-36 kg/ha) (Table 6). Using a 95% confidence interval, the differences in macronutrient quantity, by season, were not statistically significant.

Organic fertilizers were also applied by some farmer-respondents in January-June 2013 (10%) and July-December 2013 (29%) cropping periods (Table 7). On average, farmer-users applied about 700-800 kg ha^{-1}. Some organic fertilizers were placed under a subsidy program to encourage their use to improve soil quality.

Table 5. Top three fertilizers applied by farmer-respondents, West Java, Indonesia, 2013.

Fertilizer	Jan-Jun		Jul-Dec	
	% farmers	Av quantity (bags ha^{-1})[2]	% farmers	Av quantity (bags ha^{-1})[a]
Urea (46-0-0)	98	4.57	96	4.14
Compound (NPK)[b]	88	6.05	94	5.99
SP36 (0-36-0)	76	3.33	75	2.81

[a] 50 kg per bag.
[b] Fertilizer grades of 10-15-15, 10-5-5, 15-15-15, 16-16-16, and 30-6-8.

Table 6. Average quantity of macronutrients applied by farmer-respondents, West Java, Indonesia, 2013.

Macronutrient	Jan-Jun (n=100)	Jul-Dec (n=100)
N (kg ha^{-1})	148	141
P_2O_5 (kg ha^{-1})	84	76
K_2O (kg ha^{-1})	41	43

Table 7. Average quantity of organic fertilizers applied, West Java, Indonesia, 2013.

Item	Jan-Jun	Jul-Dec
Farmers (%)	10	29
Quantity (kg ha^{-1})	732	821

Farmer-respondents were able to apply these amounts because fertilizers in the country were cheap. Table 8 shows that prices of NPK, SP-36, urea, and ammonium sulfate (ZA) paid by farmer-respondents ranged from US$9 to US$11 per 50-kg bag or from US$0.18 to US$0.22kg^{-1}. The price of potassium chloride (KCl), however, was almost four times the price of the other fertilizers because it is being imported (Rachman and Sudaryanto, 2010).

Table 8. Prices of fertilizers in 50-kg bags, West Java, Indonesia, 2013.

Fertilizer	Price (US$ per 50-kg bag)
Potassium chloride (KCl) [a]	38
Compound fertilizer (NPK) [b]	11
Superphosphate (SP36) [c]	11
Urea [d]	9
Ammonium sulfate (ZA) [e]	10

[a] Fertilizer grade: 0-0-60. [b] Fertilizer grades: 10-15-15, 10-5-5, 15-15-15, 16-16-16, 30-6-8.
[c] Fertilizer grade: 0-36-0. [d] Fertilizer grade: 46-0-0. [e] Fertilizer grade: 21-0-0-24.

Indonesia produces its own fertilizers, except KCl. Fertilizer production is mainly for local use, but the country engages in export when there is excess supply (FAO, 2005). Based on the same FAO data, Indonesia is a net exporter of urea, a net importer of SP-36 and ammonium sulfate, and an importer of KCl.

Big fertilizer companies in the country are government-owned, hence, supply and distribution are controlled by the government. Additionally, 50-75% subsidy is provided to encourage application of adequate amounts of inorganic and organic fertilizers. This policy was created because most Indonesian farmers are smallholders with limited capital (Rachman and Sudaryanto, 2010).

Frequency of fertilizer application

Table 9 shows that farmer-respondents applied inorganic fertilizer at least once during the standing crop in both seasons. In the seedbed, 13% and 6% of farmers in the first and second seasons, respectively, did not use any inorganic fertilizer. These farmers also did not use any organic fertilizer in the seedbed.

Table 9. Distribution of farmers, by frequency of inorganic fertilizer application, West Java, Indonesia, 2013.

Application times	Jan-Jun		Jul-Dec	
(No.)	Seedbed (%)	Standing crop (%)	Seedbed (%)	Standing crop (%)
0	13	-	6	a
1	78	2	86	1
2	9	53	7	42
3	-	28	1	36
>3	-	17		21

- no application

In the WS, 78% of farmer-respondents and 86% in the DS applied only once during the seedling stage. Meanwhile, 81% (WS) and 78% (DS) of the farmers applied fertilizers two to three times during their standing crop.

Pesticide

Pesticide and weedicide use

Table 10 shows the top brands of chemicals used by farmers in both seasons: Themix (rodenticide), Bentan (molluscicide), Spontan (WS) and Furadan (DS) (insecticides), Indamin (herbicide), and Score (fungicide). Furthermore, records reflect a misuse of chemicals in both seasons (Table 10)—i.e., chemicals used for purposes other than what is intended. Insecticides such as endosulfan and akodan, for instance, were used as rodenticides. Also noteworthy is the classification of endosulfan as a highly toxic chemical that can greatly affect human health.

Frequency of chemical application

Table 11 shows that all respondents applied insecticides. For other chemicals, there are records of "no application." Moreover, majority of farmers (78% in WS and 70% in DS) applied insecticides more than three times. Majority applied herbicides once and most used fungicides once or twice. As to molluscicides, zero to one-time application was reported. Most of the farmers did not apply any rodenticide. However, they used non-chemical means to control rats: fencing, hunting and bombing, fumigation, or placing rat traps (Table 12). Some farmers mixed endosulfan with used oil to serve as rat poison.

Table 10. Pesticides used, West Java, Indonesia, 2013.

Jan-Jun		Jul-Dec	
Chemical brand	% farmers	Chemical brand	% farmers
Rodenticides			
Themix	18	Themix	18
Endosulfan	14	Endosulfan	12
Akodan	6	Akodan	5
Molluscicides			
Bentan	23	Bentan	34
Saponin	23	Saponin	16
Snaildown	5	Snaildown	3
Insecticides			
Spontan	42	Furadan	44
Furadan	33	Spontan	41
Prevathon	29	Lugen	24
Dafat	21	Prevathon	23
Lugen	20	Dafat	20
Herbicides			
Indamin	49	Indamin	35
Ally	27	Ally	30
Ally plus	24	Roundup	23
Roundup	22	Ally plus	19
Gramoxone	18	Gramoxone	14
Fungicides			
Score	46	Score	46
Amistartop	18	Amistartop	19
Folicur	14	Antracol	13
Antracol	11	Folicur	10
Delsen	9	Heksa	10

Table 11. Distribution of farmers, by frequency of chemical application in standing crop, West Java, Indonesia, 2013.

Chemical group	Frequency									
	Jan-Jun (n=100)					Jul-Dec (n=100)				
	0	1	2	3	>3	0	1	2	3	>3
Insecticides	-	-	7	15	78	-	4	8	18	70
Herbicides	7	70	18	4	1	10	65	22	3	0
Fungicides	20	35	23	10	12	16	34	26	14	10
Molluscicides	46	39	14	1	-	46	46	7	-	1
Rodenticides	63	22	9	4	2	72	9	9	7	3

- no application

Table 12. Distribution of farmer-respondents who used non-chemical methods of rat control, West Java, Indonesia, 2013.

Period	% farmers (n=100)
Jan-Jun	22
Jul-Dec	20

Pesticide cost

Table 13 shows that farmer-respondents' spending on insecticides accounted for more than 60% of their total chemical cost as they had more frequent application of insecticides than of other chemicals. This could imply that insect pests are more prevalent in these areas than other types of pests and diseases. This cost share is followed by fungicides (13.8% in WS and 19.9% in DS), herbicides (6.6% in WS and 6.9% in DS), and molluscicides (6.8% in WS and 7.6% in DS). Chemical costs between seasons varied but differences were not statistically significant.

Table 13. Chemical cost breakdown, West Java, Indonesia, 2013.

Chemical group	Jan-Jun (n=100)		Jul-Dec (n=100)	
	Cost (US$ ha^{-1})	Cost share (%)	Cost (US$ ha^{-1})	Cost share (%)
Herbicides	9.77	6.6	9.11	6.9
Insecticides	102.10	68.8	83.16	63.0
Fungicides	20.48	13.8	26.31	19.9
Molluscicides	10.08	6.8	10.00	7.6
Rodenticides	5.28	3.6	3.44	2.6
Other chemicals	0.61	0.41	0.02[a]	0.01
Total	148.41	100	132.03	100

Conversion: US$1 = 10,461 rupiah.

Irrigation

Irrigation water is free in West Java as it is being subsidized by the national government. Farmers incur minimal cost in paying for *ulu-ulu* services rendered by the person in charge of opening and closing the tertiary canals in the community.

In the WS, the sample farmers in West Java used the state irrigation canals (97%) as their primary source of irrigation water (Table 14). Three percent of these farmers used water pumps to draw water from the canal because rainwater is abundant during WS. The other source of water was the communal irrigation system (CIS) (3%). These farmers did not use water pumps to draw water from CIS.

During DS, the farmers who depended on the state irrigation canal slightly declined to 92% implying the difficulty of drawing water. Farmers who used water pumps even increased to 19%. Alternatively, farmers sourced out water from rivers/streams/free-flowing (6%) and natural water sources such as reservoirs/wells (2%). Among those who got water from rivers/streams/free-flowing sources, 4% used water pumps, whereas all farmers who relied on natural water sources did not use pumps.

Table 14. Distribution of farmer-respondents, by primary irrigation source and water pump usage, West Java, Indonesia, 2013.

Source of water	Jan-Jun			Jul-Dec		
	Used pumps	Did not use pumps	All	Used pumps	Did not use pumps	All
State irrigation canals	3	94	97	19	73	92
Communal irrigation systems	-	3	3	-	-	-
Rivers/streams/free flowing	-	-	-	4	2	6
Natural water sources/reservoirs/wells	-	-	-	-	2	2

Labor

There are five major activities in rice farming: land preparation (LP), crop establishment (CE), crop care and maintenance (CCM), harvesting and threshing (HT), and postharvest. LP includes plowing, harrowing, leveling, side plowing, and cleaning and repair of dikes. Meanwhile, CE involves marking straight rows, pulling and hauling of seedlings from the seedbed to the field, transplanting, and replanting. Specific activities under CCM are fertilizer and chemical application, management of irrigation and drainage facilities, and non-chemical control of pests and weeds. HT, of course, includes harvesting, collecting and piling-up of cut panicles, and threshing. Lastly, postharvest includes cleaning, blowing, bagging, and hauling of threshed paddy rice.

Labor arrangement

Farm activities can be done by hired persons, by the farmer and his family, and/or by laborers under an exchange scheme. A hired or contracted person is paid either on a daily or contract[1] basis. A daily hired laborer is normally paid in cash, while a contracted laborer is paid either in cash or in kind. The in-kind payment is usually based on a crop-share arrangement, wherein a certain percentage of the harvest is given to the laborer as payment for services rendered. Meanwhile, the labor spent by the farmer, his family, and exchange laborers does not involve any payment but is still considered a cost. It is called imputed labor.

Bawon and ceblokan

The dominant share-based labor arrangement observed in the project sites were *bawon* and *ceblokan*. In both systems, work is open to all who want to be involved in the activity but payment is given under a certain harvest-sharing arrangement, regardless of the number of hired workers. But, in some instances, farmers limit the number of workers in the field, especially when cash is provided in addition to in-kind payment or when work includes activities other than HT. Furthermore, in some instances, farmers just negotiate with a headman (or someone in charge of pooling laborers for the work). In this case, the farmer is unaware of the number of people who have worked in his field. Bawon and ceblokan are also mentioned as prevailing labor arrangement schemes in the studies of Wardana et al. (1998) and Kikuchi (1981).

Bawon is usually adopted for HT activities. Ceblokan is also a contract arrangement for HT, but it includes additional activities in CE such as transplanting. Under this arrangement, laborers provide free CE services in exchange for assured involvement in HT activities. Some farmers, however, give minimal cash payment for transplanting for the laborers' snack or food or as an additional payment. Fifty-one percent of farmers in WS and 39% in DS adopted bawon. Meanwhile, the corresponding figures for ceblokan were 13% and 21%, respectively.

1 Contract payment is based on the activity done regardless of number of days it takes to complete the work.

Table 15. Farmers who adopted the *tebasan* system and the equivalent price offer received by these farmers, by season, West Java, Indonesia, 2013.

Item	Jan-Jun	Jul-Dec
Farmer-respondents (%)	14	21
Average offer (US$ ha^{-1})	2,481	3,026

The tebasan system

Some farmers opt to do away with HT activities. This is possible under the *tebasan* system, where farmers sell paddy to traders while the crop is still standing in the field. In this case, traders are now in charge of getting people to harvest and thresh the paddy rice. This system was practiced by 14% and 21% of farmer-respondents in the January-June 2013 and July-December 2013 cropping periods respectivey (Table 15).

Average price offers for the standing crop varied across seasons. The rate was relatively higher in the second than in the first semester (Table 15). This may be because better harvest and better prices in the second semester are expected.

One of the advantages of this system is that farmers are able to receive returns earlier than the harvest period. They also do not need to allot cash for HT. Traders have a chance to earn more if actual harvest is more than what is estimated.

Labor quantity

Labor use in the WS and DS were 94 mandays (md) ha^{-1} and 96 md ha^{-1}, respectively (Table 16). These figures were not significantly different from each other. However, the amount of labor needed for major activities such as LP, CE, and postharvest significantly differed between seasons. Labor input for postharvest activities (e.g., hauling) was significantly higher in the second semester because the yield obtained in this season was significantly higher than that in the first semester.

Table 16 further shows that, in both seasons, CCM, CE, and HT were the top three components of labor. These major activities contributed 84% and 78% of total labor quantity in the 2013 WS and DS, respectively. Among the three major activities, CCM had the biggest share (28-29%) of total labor input, broken down into irrigation (21-28%), insecticide application (19-20%), non-chemical pest management like rat control and handpicking of snails (15-16%), and fertilizer application (13-14%) (Figs. 5a and 5b). These activities are manually done.

Table 16. Quantity of labor used, by major activity, and the equivalent percentage share to total labor quantity, West Java, Indonesia, 2013.

Activity	Jan-Jun		Jul-Dec		
	Quantity (md ha^{-1})	Share (%)	Quantity (md ha^{-1})	Share (%)	
Land preparation	12	13	15	15	*
Crop establishment	26	28	22	23	*
Crop care and maintenance	27	29	27	28	
Harvesting and threshing	25	27	26	27	
Postharvest	3	3	7	7	**
Total	94	100	96	100	

*, **Significance at 95% and 99% confidence intervals.

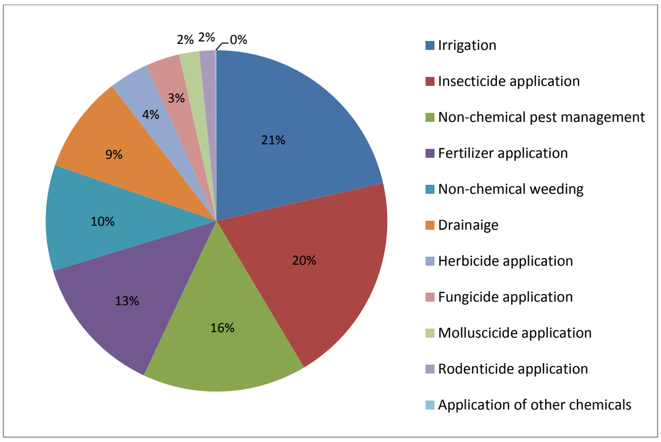

Fig. 5a. Share of specific activity in the quantity of labor used for crop care and maintenance, West Java, Indonesia, January-June 2013.

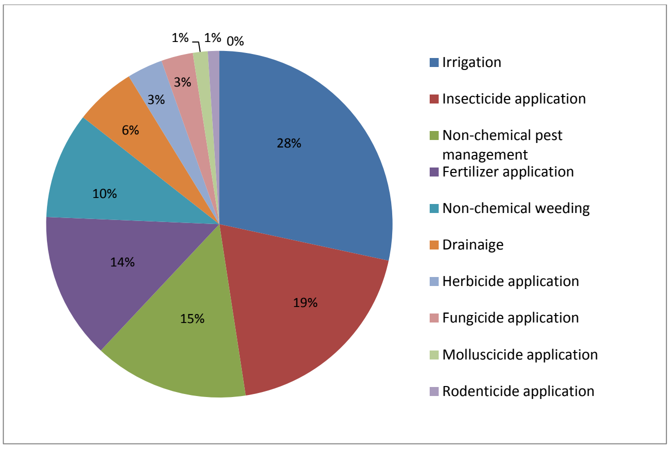

Fig.5b. Share of specific activity in the quantity of labor used for crop care and maintenance, West Java, Indonesia, July-December 2013.

CCM was followed by CE (23-28%) and HT (27%). Specific activities under CE that required more labor were transplanting (44-45%) and pulling of seedlings (27-32%) (Figs.6a and 6b), which were both done manually. Meanwhile, labor was higher for harvesting (70%) than for threshing (30%).

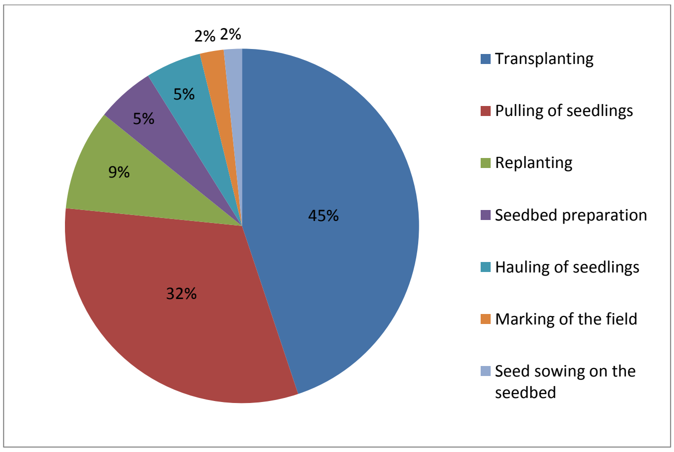

Fig. 6a. Share of specific activity in the quantity of labor used for crop establishment, West Java, Indonesia, January-June 2013.

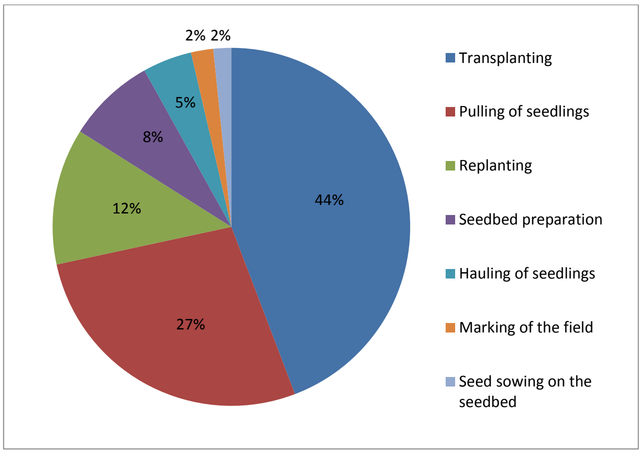

Fig. 6b. Share of specific activity in the quantity of labor used for crop establishment, West Java, Indonesia, July-December 2013.

In general, farmer-respondents still used manual labor in majority of their crop production activities, especially in CE, CCM, and HT. This partly explains the high labor input for these activities in both seasons. Results in Table 17 imply that it was only in LP where all farmers used a machine. Though majority (63% in WS and 65% in DS) used small mechanical threshers, a considerable number of farmers still manually threshed their harvest, thus the higher labor input. Very few farmers used mechanical sprayers for chemical application and water pumps for irrigation and drainage. Some farmers used trucks, cars, or motorcycles to haul their paddy and fertilizers. Table 17 further implies that crop establishment and harvesting were done using pure manual labor. Therefore, rice farming in West Java is labor-intensive.

Labor cost

Labor payment in West Java is given based on either a daily wage or contract rate (*borongan*). Most of the time, daily wage was adopted for activities related to CCM and for some activities under CE. Wage rate ranged from US$2.39 to US$14.34 md^{-1}, depending on the activity involved. Contract rates can be paid either in cash or in kind. LP, CE, and mechanical threshing were commonly paid in cash with an average contract rate of US$76.47 ha^{-1}, US$67.32 ha^{-1}, and US$66.91 ha^{-1}, respectively.

Table 17. Distribution of farmers, by type of machine used, West Java, Indonesia, 2013.

Machine	Distribution of farmers (%)	
	Jan-Jun	Jul-Dec
Hand tractor/rototiller	100	100
Water pump	2	18
Mechanical sprayer	0	1
Thresher	63	65
Motorcycle (hauling)	19	19
Four-wheel vehicle (hauling)	5	4

Manual rice threshing in West Java.

Manual HT is generally paid in kind at the usual contract rate of 1:6 crop share (Table 18). This means that, for every 6 units of harvested rice, 1 unit is given to harvesters and threshers as payment.

Table 18. Daily wage and contract rates, West Java, Indonesia, 2013.

Item	Amount/ratio
Daily wage rate (US$ manday^{-1})	2.29-14.34
Contract rate/sharing arrangement	
Land preparation (US$ ha^{-1})	76.47
Crop establishment (US$ ha^{-1})	67.32
Manual harvesting	6:1 sharing
Mechanical threshing (US$ ha^{-1})	66.91
Manual H/T*	6:1 sharing

*H/T means harvesting and threshing. Common sharing arrangement is represented by a ratio.

The agreed crop-sharing arrangement for manual HT involves the same rate given to manual harvesters even if farmers use mechanical threshers. The operators of the threshing unit are paid separately; this constitutes additional cost to farmers. This implies that farmers who employ manual threshing pay less than those who use mechanical threshers, and this explains why farmers prefer manual threshing. However, mechanical threshing is more efficient and farmers are able to sell their produce ahead of those who employ manual threshing.

A breakdown of total labor cost in 2013, by major activity, shows that HT (49%), CCM (24%), and CE (16%) mainly comprise total labor cost in 2013 (Fig. 7). The percentage share of these three major activities totaled 90%. As mentioned earlier, these activities are mainly done manually, explaining for their big share in total labor cost.

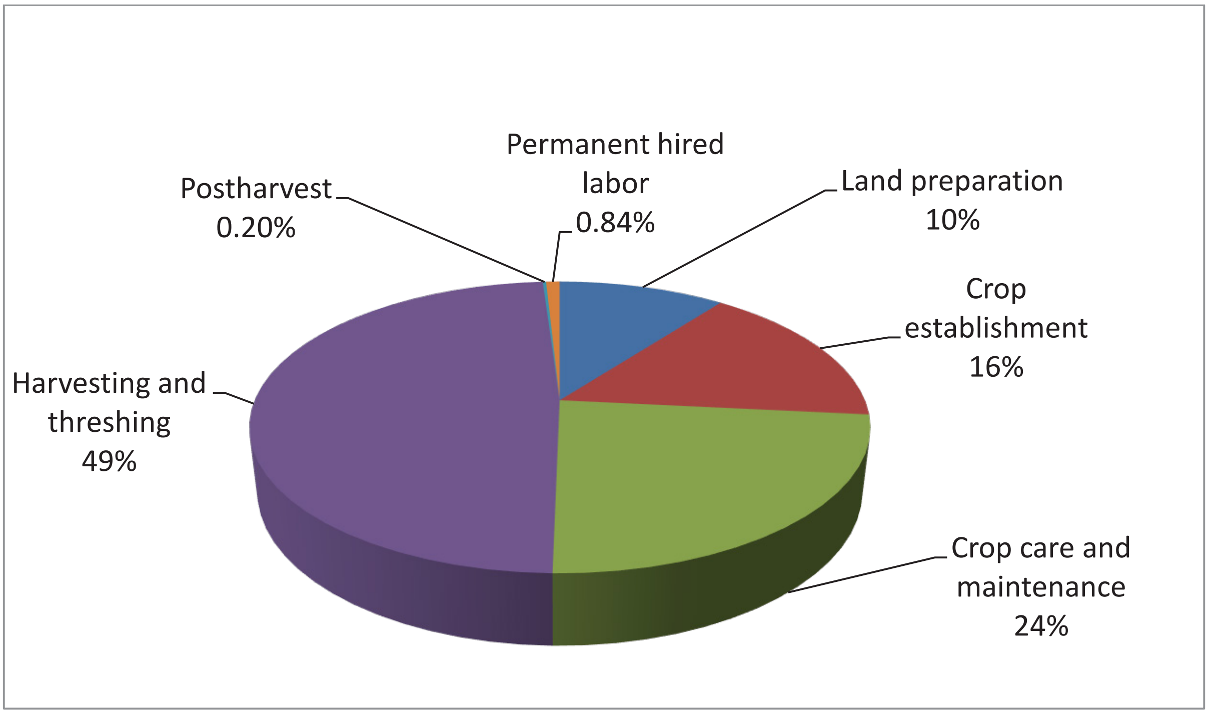

Fig. 7. Breakdown of total labor cost, by major activity, West Java, Indonesia, 2013.

Figure 8 shows that total labor cost in 2013 comprised mainly hired labor. Eighty one percent came from hired labor and only 19% was from imputed[2] labor. This implies that farmers are not the main workers in the field. They are involved heavily in supervision and monitoring of hired laborers only. Figure 8 further shows that labor cost for HT was purely for hired labor. More than 65% of total labor spending on LP, CE, and postharvest was also hired. Meanwhile, spending for CCM mainly covered imputed labor cost (67%).

Factor productivity

Table 19 shows the partial productivity of land, labor, and nitrogen, which is the ratio of the quantity of output to a factor input. Partial productivity measures how much rice is produced per unit of each of these inputs.

Land productivity results show that yield (in fresh weight) obtained in the DS (7.01 t ha^{-1}) was relatively higher than that in the WS (6.67 t ha^{-1}). The favorable solar condition in the DS brought about the better yield. Compared with RTDP results in 1999 (4.4 and 5.3 t ha^{-1} in WS and DS, respectively) (Moya et al.,

2 Contributed by the farmer, his family, and exchange labor.

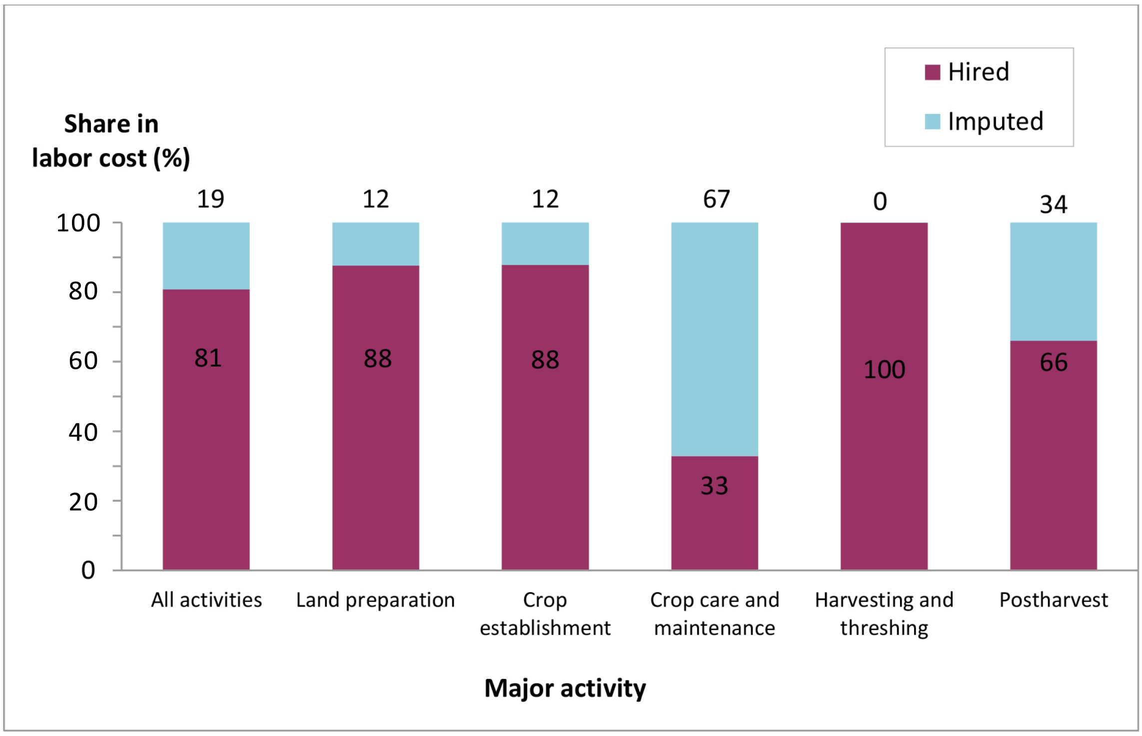

Fig. 8. Breakdown of labor cost of major activities, by type of labor used, West Java, Indonesia, 2013.

Table 19. Partial productivity of land, labor, and fertilizer, by season, West Java, Indonesia, 2013.

Factor	Jan-Jun		Jul-Dec		Ave	
	Wet form	Dry form[a]	Wet form	Dry form[a]	Wet form	Dry form
Land (kg paddy ha^{-1})	6,656	5,417	7,010	6,113	6,833	5,765
Labor (kg paddy person-$days^{-1}$)	71.1	57.9	72.9	63.6	72.0	60.7
N (kg paddy kg N^{-1})	45.0	36.6	49.6	43.3	47.3	40.0
P_2O_5 (kg paddy kg P^{-1})	79.2	64.5	91.8	80.0	85.5	72.2
K_2O (kg paddy kg K^{-1})	163.9	133.4	163.1	142.3	163.5	137.8

[a] Used moisture content of 30% (Jan-Jun 2013, WS) and 25% (Jul-Dec 2013, DS). This is based on key informant interviews.

2004), yields obtained by farmers in 2013 were higher during both seasons. Therefore, yield levels improved from 1999 to 2013. Based on moisture content (MC) of 30% (WS) and 25% (DS)[3], the dry equivalent weight of 2013 yields in the two seasons were 5.42 and 6.11 t ha^{-1}, respectively. Using the averages of these dry weights and of N application, partial productivity of N (PPN) in dry form is then 40 kg dry grain kg^{-1} N. This is practically similar to the PPN of farmers' fertilizer practice (FFP) (39.7 kg grain kg^{-1} N) and is even lower than the PPN of site-specific nutrient management (SSNM) plots (47.9 kg grain kg^{-1} N) at Sukamandi, West Java, in 1997-99 (Abdularachman et al., 2004). This implies that, although yield improved through time, PPN did not. The amount of paddy produced using a unit of N in 2013 is almost the same as that produced per unit of N 14 years ago. Therefore, yield improved over time in

3 Based on key informant interviews.

intensively cultivated and irrigated areas in West Java because of increases in the quantity of applied N and not because of improved N productivity.

Table 19 shows values of partial productivity of labor (PPL) in WS and DS: 58 and 64 kg dry grain md^{-1}, respectively. These results are substantially higher than the 1998 PPL derived from the study of Abdulrachman et al. (2004) using data from 20 farmers in Sukamandi, West Java. Their paper shows a median labor input of 142 md ha^{-1} (DS) and 159 md ha^{-1} (WS) and median yields of 2.54 t ha^{-1} (DS) and 5.67 t ha^{-1} (WS). Hence, using these data, the resulting PPL in 1998 were 18 and 36 kg grain md^{-1} in DS and WS, respectively. This low PPL is mainly attributed to high labor input. According to Moya et al. (2004), the high labor use in 1998 could be due to the migration of laborers from urban to rural areas, which was induced by the 1997 economic crisis. A comparison of the 1998 and 2013 PPL, therefore, shows that productivity of labor was better in 2013 than in 1998; more rice was produced per unit of labor in 2013. This can be explained partly by some farmers shifting from manual to mechanized activities, specifically in threshing.

Cost and profitability

Land rent constituted a huge portion of the farmers' production cost (41-43%); hired labor was 27-28% (Table 20). The literature mentions the high demand for rice fields as people find rice farming very profitable (Pearson et al., 1991), which could explain for high land rent. Figure 4 supports this by showing that rice is still the main source of income of rice farming households. The land rent presented in Table 20 is the average of actual and imputed values for rent. For landowners, rent was imputed to reflect the opportunity cost of using their land for their own production instead of renting it out or using it to grow other crops. These imputed values came from the average land rent of nine (WS) and eight (DS) farmers with actual spending on rent. Meanwhile, as discussed in earlier sections, farmers mainly hire people to work in the field and that activities are generally done manually. These could explain hired labor's high share in the production cost.

Table 20. Details of rice production cost of farmer-respondents, West Java, Indonesia, 2013.

Cost item	Jan-Jun		Jul-Dec		
	Cost (US$ ha^{-1})	Share (%)	Cost (US$ ha^{-1})	Share (%)	
Seed	20.00	0.96	20.11	0.92	
Fertilizer	145.62	6.96	138.58	6.37	
Pesticides	148.31	7.09	132.03	6.07	
Hired labor	555.92	26.57	609.29	28.00	*
OFE labor[1]	127.94	6.11	150.26	6.90	
Animal, Machine, Fuel & Oil	67.38	3.22	68.89	3.17	
Irrigation	8.36	0.40	19.92	0.92	***
Food	24.11	1.15	41.14	1.89	
Transportation	4.04	0.19	14.11	0.65	
Tax	19.92	0.95	27.46	1.26	***
Land rent	908.06	43.40	888.73	40.84	
Interest on capital	38.08	1.82	49.04	2.25	**
Other Inputs	24.73	1.18	16.61	0.76	***
Total production cost	2,092.46	100.00	2,176.19	100.00	

*, **, *** indicate significance at 90%, 95%, and 99% confidence levels.
[1] Operator, family, & exchange labor
Conversion: US$1 = 10,461 Indonesian Rupiah

A comparison of costs between seasons shows that hired labor, irrigation, tax, and interest on capital were significantly different from each other. Hired labor cost was high in the second season primarily because of higher yield during this time. Payment for hired labor is crop share-based, thus, higher yield means higher labor payment. The July-December 2013 period is DS in Indonesia, which could explain the season's higher irrigation cost. The higher interest on capital in the second season may be explained by the higher cost incurred by farmers in the latter period. Interest on capital represents the opportunity cost attached to the sum of money invested on rice farming.

Results of cost and return analysis (Table 21) show that the average gross returns earned by farmers were still higher than the average total production cost. Farmers gained a net income of US$598 ha^{-1} in WS and US$845 ha^{-1} in DS. With an average household size of four, these incomes are still above the 2013 poverty threshold of US$367 and US$409 for a four-month period.[34] Net income with own labor gave them higher returns at US$726 ha^{-1} in January-June 2013 and US$996 ha^{-1} in July-December 2013.Furthermore, if

Table 21. Cost and returns (in US dollars) of rice production, West Java, Indonesia, 2013.

Item	Jan-Jun	Jul-Dec	
Total Returns			
Yield (kg ha^{-1})	6,655.67	7,009.87	*
Paddy price (US$ kg^{-1})	0.40	0.43	***
Gross revenue (US$ ha^{-1})	2,690.32	3,021.65	***
Total cost (US$ ha^{-1})	2,092.46	2,176.19	**
Cost per kg (US$ kg^{-1})	0.31	0.31	
(A) Net income from rice farming (US$ ha^{-1})	597.86	845.46	**
(B) Net income from rice farming plus own labor (US$ ha^{-1})	725.80	995.72	
(C) Net income from rice farming plus own labor and land rent (US$ ha^{-1})	1,633.86	1,884.46	
(D) Net income from rice farming plus own labor, land rent, and capital (US$ ha^{-1})	1,671.93	1,933.50	

*, **, *** indicate significance at 90%, 95%, and 99% confidence levels.

Conversion: US$1 = 10,461.24 Indonesian Rupiah

farmers used own labor and land, net income would even be higher at US$1,634 ha^{-1} in WS and US$1,884 ha^{-1} in DS. Net income C was three times higher than net income A. Finally, if the farmer used own labor, land, and capital, net income D would be US$1,672 ha^{-1} and US$1,934 ha^{-1} in the respective seasons. These results imply that farmers can receive better "financial" income if own labor (in some activities), land, and capital were used. The net income increment is highest when a farmer cultivates his own land.

The positive and better income in the second semester was driven by higher yield and better paddy price in this period. Consequently, farmers gained additional US$331 gross returns in the second semester. This increase in gross returns was sufficient to cover the higher average total production cost in the second

[3] This was computed using poverty lines for March and September 2013 estimated by Badan Pusat Statistik of Indonesia. (http://www.bps.go.id/Subjek/view/id/23#subjekViewTab3|accordion-daftar-subjek1).

semester, which was primarily due to higher hired labor cost. Nevertheless, the cost of producing 1 kg of paddy was the same in both seasons. This implies that every US$1.00 spent by a farmer would produce the same amount of paddy in both seasons, in spite of the more favorable solar condition in the second semester.

Rice marketing

There are five major players in the rice marketing system (Fig. 9). These are the farmers, traders, millers, wholesalers, and retailers. Farmers sell their rice paddy to two kinds of traders. One group buys paddy rice at the threshing site, while the other buys the crop still standing in the field. The latter is called the tebasan trader. In the tebasan system, traders estimate the quantity of paddy rice that may be harvested from the field by visual inspection. The corresponding value is paid to farmers before harvest. The tebasan traders shoulder the costs in harvesting, threshing, hauling, weighing, and other postharvest activities. The Bureau of Logistics or BULOG also buys paddy from farmers (Tobias et al., 2012). The BULOG is a government institution in Indonesia that is mandated to deal with food distribution and implementation

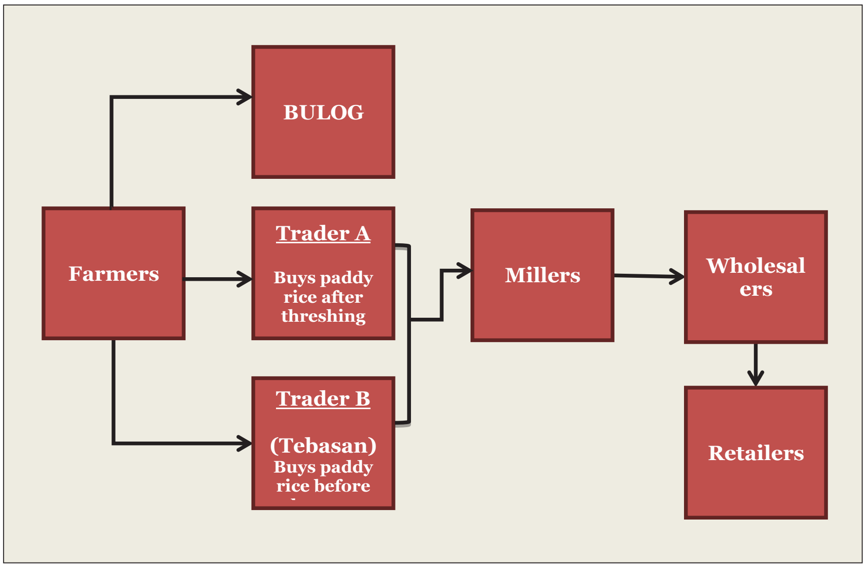

Fig. 9. Common rice marketing channels in Indonesia.

Rice paddy ready for selling at the threshing site.

of its rice price stabilization policy. It buys rice produce not absorbed by the market during harvest season. The rice procured by BULOG is used as a national buffer stock (Arifin, 2008)

After buying rice from farmers, traders sell this to millers, who, in turn,sell to wholesalers. Meanwhile, the rice sold to wholesalers is distributed to retailers.

Results also show that 88% of the farmers sold their paddy rice in fresh form to paddy traders who pick up paddy rice from the threshing location. However, 30% of the farmers did not sell all of their harvest but retained some for home consumption.

Solar drying of paddy rice.

SUMMARY & IMPLICATIONS

Rice farming in West Java has improved in terms of yield possibly because of low seeding and high fertilizer rates. The low seeding rate can be attributed to good practices such as straight row planting, legowo or tegel, and the use of high-quality seeds. On the other hand, the observed high fertilization may have been affected by the government subsidy on fertilizers to help farmers. This might have motivated them to apply more fertilizers than what are actually needed, consequently affecting the farm's nitrogen efficiency.

In spite of the observed improvement in labor productivity, rice farming in West Java remains labor-intensive because farmers still manually operate majority of their activities. A huge part of labor inputs are still used in CE, HT, and CCM, specifically irrigation, insecticide application, non-chemical pest management like rat control and snail picking, and fertilizer application. These activities are manually done, except for threshing, with some farmers already using mechanical threshers. Nevertheless, a number of them (35-37%) still manually thresh their paddy.

It was also observed that, even with the developments in rice farming, West Java farms are still less mechanized. This led to high labor demand and cost. Land preparation is the only activity where all farmers used an equipment. The government might want to consider creating a mechanization program that could deliver the needed equipment to further advance rice farming. The objective is to save farmers' time and money and reduce postharvest losses. Addressing this issue can help farmers reduce one costly input in their production, that is, hired labor. This can also increase their harvest because of minimal losses.

Further studies on labor payment arrangement can be conducted to determine if the existing crop-share arrangement is the best scheme for activities that are contracted out. The output-based payment for labor is one of the reasons hired labor is costly. This means that an increase in total harvest will lead to an increase in payment for labor.

Results of the cost and return analysis imply that rice farming is profitable in West Java. Farmer-respondents earned positive net income in both seasons. Farmer-landowners earned even higher returns. This income can be improved further if labor cost is reduced through mechanization and better labor payment arrangement.

REFERENCES

Abdulrachman S, Susanti Z, Pahim, Djatiharti A, Dobermann A, Witt C. 2004. Site-specific nutrient management in irrigated rice systems of Tamil Nadu, India. In: Dobermann A, Witt C, Dawe D, eds. Increasing productivity of intensive rice systems through site-specific nutrient management. Enfield, N.H. (USA): Science Publishers, Inc., and Los Baños (Philippines): International Rice Research Institute. p 171-192.

Ali M. 1996. Quantifying the socioeconomic determinants of sustainable crop production: an application to wheat cultivation in the Tarai of Nepal. Agric. Econ. 14:45-60.

Arifin B. 2008. From remarkable success stories to the troubling present: the case of BULOG in Indonesia. In: Rashid et al., eds. From parastatals to private trade: lessons from Asian agriculture. USA: International Food Policy Research Institute. p 137-171.

BPS-Badan Pusat Statistik. 2015. Statistical yearbook of Indonesia, 2012. Jakarta, Indonesia: BPS. 670 p.

Cassman KG, Pingali PL. 1995. Extrapolating trends from long-term experiments to farmers' fields: the case of irrigated rice systems in Asia. In: Barnett V, Payne R, Steiner R, eds. Agricultural sustainability in economic, environmental, and statistical terms. London: J. Wiley & Sons. p 64-84.

FAO- Food and Agriculture Organization. 2005. Fertilizer use by crop in Indonesia. Rome (Italy): FAO. 62 p.

Hidayah, I. 2013. Farmers' behavior in the implementation of component PPT (integrated plant and resource management) in irrigation paddy fields farming in Buru regency Maluku province Indonesia. Int. J. Hum. Soc. Sci. 3(12): 129-138.

Huang JK, Rozelle S. 1995. Environmental stress and grain yields in China. Am. J. Agric. Econ. 77: 853-864.

Kikuchi M. 1981. Changes in rice harvesting systems in the Philippines and Indonesia: village structure and choice of contractual arrangements. Dev. Econ. 19(4): 291-304.

Moya PF, Dawe D, Pabale D, Tiongco M, Chien NV, Devarajan S, Djatiharti A, Lai NX, Niyomvit L, Ping HX, Redondo G, Wardana P. 2004. The economics of intensively irrigated rice in Asia. In: Dobermann A, Witt C, Dawe D, eds. Increasing productivity of intensive rice systems through site-specific nutrient management. Enfield, N.H. (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 29-58.

Pearson, SR, Falcon, W, Heytens, P, Monke, EA, Naylor, R. 1991. Rice policy in Indonesia. Ithaca, NY (USA): Cornell University Press. 180 p.

Rachman B, Sudaryanto T. 2010. Impacts and future perspectives of fertilizer policy in Indonesia. Indonesian Cent.Agric. Socioecon. Policy Stud. 8(3): 193-205.

Tobias A, Molina I, Valera HG, Mottaled KA, Mohanty S. 2012. Handbook on rice policy for Asia. Los Baños (Philippines): International Rice Research Institute. 47 p.

USDA-United States Department of Agriculture. 2012. Indonesia: stagnating rice production ensures continued need for imports. Community intelligence report, USDA Foreign Agricultural Service. http://www.pecad.fas.usda.gov/highlights/2012/03/Indonesia_rice_Mar2012. Accessed 10 February 2015.

Wardana IP, Farid A, Huelgas ZM. 1998. Baseline profile of on-farm soil fertility management in the Jatiluhur irrigation system, West Java, Indonesia. In: Olk DC, Moya PF, eds. On-farm management of applied inputs and native soil fertility. IRRI Discuss. Pap. Ser. No. 23. p 133-146.

AUTHORS

Aileen C. Litonjua is a senior science research specialist of the Socioeconomics Division, Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

Putu I. Wardana is a senior scientist of the Socioeconomics Division, Indonesian Center for Food Crops Research and Development, Bogor, West Java, Indonesia.

Suennie Jane C. Paran is science research specialist of the Socioeconomics Division, Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

Ma. Shiela D. Valencia is an assistant scientist at the International Rice Research Institute, Los Baños, Laguna, Philippines.

Francia M. Macalintal is chief of the Sectoral Policy Development Section, Philippine Council for Agriculture and Fisheries, Quezon City, Philippines.

Flordeliza H. Bordey is chief science research specialist of the Socioeconomics Division, Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines.

Piedad F. Moya is a consultant of the Social Sciences Division, International Rice Research Institute, Los Baños, Laguna, Philippines.

ISBN 978-621-8022-05-8

978-621-8022-05-8