Scientific Research Publishing

Open Journal of Ecology, 2025, 15(2), 205-226
https://www.scirp.org/journal/oje
ISSN Online: 2162-1993
ISSN Print: 2162-1985

Promotion of Special Purpose Rice Production Technology in Selected Municipalities in Nueva Ecija, Philippines

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How to cite this paper: Kwan, R., Badua, A., Lagasca, A., Mercado, J.J., Baltazar, E., Mercado, T.J., Pagaduan, N. and Orden, E. (2025) Promotion of Special Purpose Rice Production Technology in Selected Municipalities in Nueva Ecija, Philippines. *Open Journal of Ecology*, **15**, 205-226.
https://doi.org/10.4236/oje.2025.152012

Received: January 4, 2025
Accepted: February 25, 2025
Published: February 28, 2025

Abstract

Special Purpose Rice (SPR) is a technology that consists of different rice varieties that were developed by Central Luzon State University. The unique varietal characteristics of SPR are pigmented, glutinous, good-yielding varieties planted in lowland areas. This study was conducted to increase farmers' income through employing different promotion and extension activities and enterprise development. Data were analyzed using descriptive statistics. Cost and return and benefit-cost analysis were used to determine the financial benefits of using the SPR in different production systems. Results revealed that incorporating the following parameters is critical in the sustainable adoption of the SPR. Amongst them are: ensuring that recommended production technologies are strictly followed by the farmers, ensuring the quality of seeds for planting, the presence of a market for the produce, engaging the farmers in value-adding activities like processing, capability development in entrepreneurship, and adopting clustering approach of the farmers to address economies of scale in marketing and processing. The use of SPR produced an average yield of 6.11 MT/ha and 5.04 MT/ha during the dry and wet seasons from 2021-2023, respectively, higher than the usual varieties of inbred rice. The net benefit from producing a CLS-2 variety of SPR is higher than regular rice, having an average difference of Php 22,355.53 per hectare from 2021-2023.

Keywords

Special Purpose Rice, Technology Promotion, Extension Activities, Enterprise Development

1. Introduction

Rice is a staple food and the main source of carbohydrates for many Filipinos' dietary allowance. It is widely produced and is the most important food crop in most countries. It is more extensively produced in Central Luzon where it plays an important role in the region's food supply and economy. Central Luzon remained the top producer of palay in the country where it produced a total of 1.1 million metric tons or 26.7 percent share of the total palay production in 2020 [1]. According to the Department of Agriculture (DA) Communications Group (2020), after attaining the target to increase palay production during the 2019-2020 dry season, the department is now aiming to promote rice varieties preferred by consumers after dialogues with rice millers and traders from Central Luzon and other regions of the country. According to DA Secretary William Dar, consumers' preference for quality rice will become an integral part of the overall transformation of the country's rice industry.

Nueva Ecija is known as the "Rice Granary of the Philippines." It is the largest province and the biggest rice producer in Central Luzon, with a total land area of 318,284 hectares devoted to rice production. Based on data from the Office of the Provincial Agriculturist (OPA), some 4973.35 hectares with 1695 farmers are growing traditional and modern varieties of specialty rice in Nueva Ecija. Of the total area, 54.6 hectares (1%) are utilized for seed production of special rice. The top producing areas are Carranglan, Guimba, Llanera, Science City of Muñoz, and Sto. Domingo. The average yield per hectare is 5 - 6 MT for the traditional varieties of specialty rice per hectare, while it is 6 - 8 MT per hectare for the modern varieties. These special rice varieties are usually planted in lowland irrigated areas during the wet and dry seasons (PhilRice and CLSU, 2014-2015).

The CLSU Research Office (now center), together with PhilRice and the Department of Agriculture (DA), has done research and development (R&D) projects on special rice which includes aromatic and pigmented rice due to the rising demand for the product in both local and international markets. The aim is to develop high-yielding and quality varieties that are resistant to biotic and abiotic stresses and can be grown in a wide range of agroecological zones. So far, the projects have already developed special rice lines which are now being evaluated under Preliminary Yield Trials (PYT) and Advanced Yield Trials (AYT). These could be candidates for Plant Variety Protection (PVP) and NSIC registration. With the joint efforts of the group of researchers working on special rice, the conventional breeding techniques and the application of advanced breeding tools such as tissue culture, marker-assisted selection, and genetic engineering to be implemented as soon as the equipment becomes available, commercialization of special rice will be pushed.

While there have been significant technological advancements in rice research, farmers' profits continue to fall short of their maximum potential due to various socio-economic limitations. Farmers often lack the necessary management skills to make informed decisions that would enhance their profits. Additionally, their

ability to transform rice farming into a successful agribusiness venture remains limited. Among the numerous contributing factors, the lack of sound marketing strategies significantly hinders farmers from achieving higher profitability. This is primarily because farmers possess minimal knowledge and skills for effective negotiations with potential buyers, leaving them with few alternatives other than selling their harvest in traditional markets.

To strengthen and broaden the promotion and adoption of special-purpose rice production, the technology was demonstrated as part of a component project within the Techno Village Development Program (TDVP) by CLSU in Talavera and Science City of Munoz, Nueva Ecija. TDVP is an extension of innovation that promotes essential technologies developed by CLSU, effectively transforming villages into technological hubs. Notably, special-purpose rice production quickly emerged as one of the most, if not the most, popular technologies within the program. Scores of farmers were motivated to explore and embrace this technology. Consequently, it becomes imperative to focus on the enterprise and marketing aspects of the project.

2. Methodology

The study was implemented following the framework suggested by the WK Kellogg Foundation (2004) [2] as presented in Figure 1. Based on the logic model, the framework provides a road map of the study. It shows what the study will do and what it is to be accomplished. It shows the logical relationships among the resources, activities, and results as they relate to the study goal. The framework consists of basic elements, namely: inputs, processes, outputs, and outcomes.

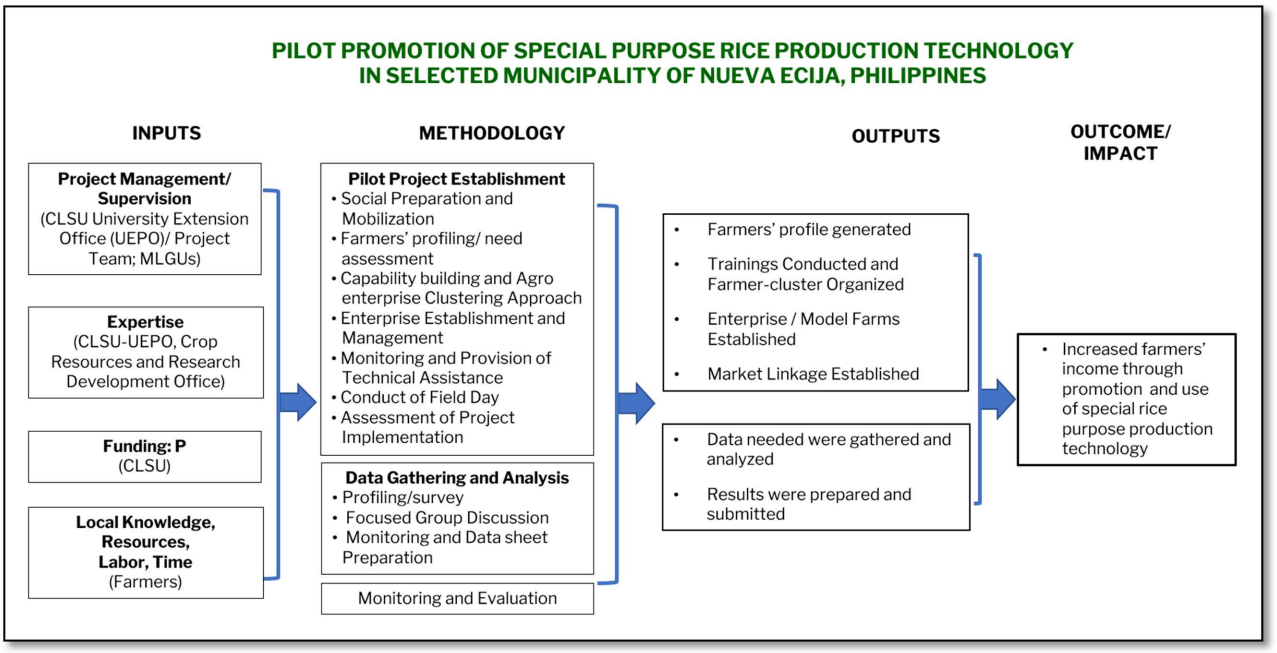

Figure 1. Conceptual framework of the study.

2.1. Pilot Project Establishment

This portion presents and discusses the different activities undertaken by the project to facilitate the promotion and utilization of special rice production technology in selected municipalities of Nueva Ecija.

2.1.1. Social Preparation and Mobilization

a) Area Selection

The Techno Village Development Program (TVDP) was launched in February 2020 in Talavera and Science City of Munoz, Nueva Ecija, in response to the strong commitment and access of municipalities and local government units (LGUs) to agricultural services. The process began with initial meetings with LGU representatives and farmers' organizations, such as Talavera. The Talavera Unlad Farmers Association (TUFA) and the Cabisuculan Mushroom Growers Farmers Association (CMGFA) expressed their strong endorsement for the establishment of the CLS2 model farm dedicated to special rice production.

The Talavera local government mainly consists of agriculture and enhanced various types of progeny production, cultivation, and management practices and different activities such as Vegetables, Pulses, Onions, and Fruit Trees among others. The municipality's soil types, particularly Maligaya Silt Loam and Quingua Silt Loam, are highly conducive to agriculture, enabling diverse crop production across approximately 856 hectares of farmland (Provincial Government of Nueva Ecija, 2015). The distribution of land titles to farmers further emphasizes the importance of Talavera as an agricultural center [3]. In addition to this, the City of Science in Munoz, recognized as the first science city in the Philippines, plays an important role in boosting agricultural development, providing several research institutes dedicated to agricultural science and technology. Rice farming is the municipality's primary economic activity, with around 9819 hectares dedicated to agriculture [4]. Together, these communities form a solid foundation for TVDP and are used to promote sustainable agricultural practices, development, and innovation.

b) Project presentation in the Barangays

Meetings were conducted in selected barangays of Talavera and Science City of Muñoz, Nueva Ecija to present the projects, including the special purpose rice production initiative under the Techno Village Development Program (TVDP). Barangay leaders and members of farmers' associations, specifically the Talavera Unlad Farmers Association (TUFA) in Talavera and Cabisuculan Mushroom Growers and Farmers Association (CMGFA) in Science City of Muñoz, Nueva Ecija, have attended the meeting.

The presentations aimed to inform farmers about the TVDP, particularly the Special Purpose Rice Production Project. Given the documented advantages of CLS2 over traditional varieties, the project's prioritization of this special rice variety is highly anticipated by farmers.

c) Farmer-Partner Selection and Site Validation

After the meetings in the barangays, farmer partners for the technology

demonstration were selected based on a set of criteria for the project. To qualify, farmers must be rice farmers. They must also be willing to: 1) participate in the project; 2) provide equity such as paddy areas for rice production, labor, and other inputs; 3) attend training and meetings; 4) follow the recommended practices; and 5) share the technologies and open their farms to interested rice farmers and groups.

Site validation was done by technical specialists and extension personnel from CLSU. This was to assess whether the sites could sustain the production of special-purpose rice. Oftentimes, the activity was done with the LGU extension workers assigned to the barangays and farmer leaders.

2.1.2. Profiling, Needs Assessment, and Bench Marking Activities

Farmer profiling was conducted among the farmer cooperators to generate information on their socio-demographic and economic status at the start of the project. In addition, Information Need Assessment (INA) and Training Need Assessment (TNA) were done to determine farmers' information and training needs when it came to special rice production and related farming practices. Moreover, during the benchmarking activities, the attitude of farmer-cooperators towards special-purpose rice production was determined while their knowledge and skills on the technology were obtained in the pre-test before the training or capability building.

The results were used as a basis for developing training and information education and communication (IEC) materials. The results of the farmers' profiling would also be useful in assessing the project's impact later on.

2.1.3. Capability Building and Agro-Enterprise Clustering Approach (AECA)

To improve the knowledge and skills of farmers in managing CLS2 production, a two-day comprehensive training program was implemented every year. The training focused on two main areas: recommended cultural practices for special-purpose rice and effective enterprise development and management through the Agro Enterprise Clustering Approach (AECA). Resource persons included technical specialists from CLSU.

The training included various strategies, such as interactive lectures and discussions, actual demonstrations, and hands-on workshops. A significant portion of the training and capacity-building initiatives occurred directly within the fields of one of the farmer cluster members, facilitating practical application and immediate learning experiences. During the training, the farmer-partners were organized into clusters. They were trained to manage their enterprises by following the AECA model, which served as a guide for farm management improvements, market preparation, actual market engagement, and the establishment of agro-enterprises or marketing businesses.

IEC materials were prepared and distributed to the participants during the training. These materials served as ready references and guides to the technologies. Pre-tests and post-tests were administered to evaluate the knowledge gained and the learning increments during the training.

The Agro-Enterprise Clustering Approach (AECA) is a farmer-centric strategy that facilitates the formation of clusters among smallholder farmers. This intervention enhances profitability and productivity by providing access to improved market options, thereby contributing significantly to the development of rural agricultural areas. The main focus was on market opportunities, cooperation, and enhancing the viability of agricultural enterprises.

The AECA comprised eight distinct phases. A technical working group (TWG) was established, and key farmer clusters were developed from partner municipalities Talavera and Science City of Muñoz. This working group consisted of members from, the partner agricultural organizations, Central Luzon State University, cluster leaders, and the local government unit (LGU). Throughout the process, this technical working group (TWG) guided and supported the farmers as they facilitated agro-enterprise activities. The farmer cluster included ten to fifteen farmers and was formed based on similarities in goals, location, or interest. Collective action was built within these clusters to address market-related challenges, resource management, and production issues. This working group played a critical role in ensuring the proper implementation of agro-enterprise projects by providing necessary technical assistance, conducting training, and supplying essential start-up materials like seeds and fertilizer. By working together, the farmers created a strong base of support that enabled them to accomplish their goals, which were to grow their joint venture and make money through it.

Pigmented rice is one of the products that the farmer clusters from the project discussed in the second and third steps, along with potential partner buyers and marketing channels. To identify the pigmented rice (CLS2) that could be produced most profitably, the cluster examined its existing resources, expertise, and production capacities. The farmer group was also able to identify potential buyers who fit into the wholesaler, retailer, or institutional market categories by conducting market research to understand price trends and demand preferences. This analysis helped them produce according to market needs, creating better opportunities for sales and profitability. This step was crucial for making informed decisions that led to sustainable and successful SPR rural-based enterprises.

In the fourth step, the commitment of each member was secured, and the cluster's policies regarding agro-enterprise (AE) activities were established. This process ensured that all members fully understood and agreed to their roles and responsibilities within the cluster. Each member's commitment was essential to maintaining active participation and cooperation. Clear policies were set to guide the group's operations, including rules on decision-making, resource sharing, financial contributions, conflict resolution, and adherence to production and market plans. The establishment of these policies resulted in a structured framework that fostered accountability, fairness, and efficiency. This approach ensured the effective implementation of agro-enterprise activities, contributing to the long-term success of the cluster and the sustainability of the project.

Completing the cluster's collective marketing plan, which acted as their enterprise engagement guide, was the fifth step. In this plan, the specific product they

had decided to specialize in was listed, along with the kinds of buyers the farmers should target in the case of dried pigmented rice grain. This included setting production quantities to ensure product quality and establishing timelines for harvesting and delivery. The cluster strategized pricing, marketing, and logistics to effectively respond to market demand. With their efforts coordinated, the members pooled their resources, negotiated better prices, and significantly reduced costs by leveraging economies of scale. This approach strengthened their bargaining power, enhanced competitiveness in the market, and ensured a steady income for the farmers.

The cluster kept a close watch on its crops and forecasted supply to meet partner buyers' requirements for product quantities for sale in Gapan and Science City of Muñoz, Nueva Ecija. This involved regular farm visits, checking crop growth stages, and assessing possible yields. By consistently tracking their production progress, the cluster was able to anticipate problems, including pests, diseases, or weather-related conditions, and take necessary measures in due time. The supply forecast relied on anticipated yields from harvests and their timings, enabling the cluster to efficiently manage marketing and the supply chain. This proactive strategy consistently met the partner buyers' needs, averting shortages and establishing a reliable market presence in niche segments.

In the seventh step, the cluster carried out actual deliveries to the market or conducted test marketing. This phase involved bringing their products to the market for sale or testing with selected partner buyers in Gapan and in the Science City of Muñoz in Nueva Ecija. The group assessed how well the goods were received, focusing on aspects such as product quality, pricing, packaging, and buyer feedback. This initial test helped identify any issues in the supply chain, distribution, or customer preferences that needed addressing. Based on the results, the cluster made necessary adjustments to improve future delivery processes, ensuring smoother operations, better customer satisfaction, and higher sales.

In the eighth step, based on the assessment of the test delivery, a plan was developed for regular and continuous collective business operations. At the end of the test marketing phase, the cluster reviewed the findings, analyzed areas of enhancement, and drew up a plan for fine-tuning the operations of the cluster. In this plan, some of the activities that were implemented included the enhancement of production approaches, changes to the existing prices for products, finding better ways of delivering the products to the market and standardizing the quality of the products that were produced. Additionally, the cluster used customer feedback to tailor its provisions according to the desired needs of the consumers. The objective was to create a viable and remunerative business model under which the cluster could operate stably in the long term and deliver products to the market on a consistent, if not constant, basis. This planning ensured the sustainability of the cluster, as well as its capability to adapt and expand to market trends.

AECA enhances farmers' income and returns on effort and capital by promoting cooperative models and purchasing power in resource acquisition, thereby

reducing production costs. Market access improves due to established partnerships, which result in fixed pricing and guaranteed sales, thereby meeting the buyer's objectives. Safe handling and proper storage have decreased post-harvest losses while enhancing yields and quality. Therefore, in a social sense, AECA supports the development of leadership in the many farmers and promotes teamwork and decision-making through a clustering approach. Thirdly, it encourages the use of suitable farming technologies that can be applied to other crops and communities. Farmer feedback and feedback on provider satisfaction are used to quantify farmer satisfaction, which is another success factor. In general, AECA outlines a deliberate, ongoing process that helps farmers achieve stability and enhance their agricultural performance.

2.1.4. Enterprise Establishment and Management

Eleven (11) model farms were established as pilot enterprises in selected municipalities to showcase the technology. The identified farmer-partners have put up a minimum area of 2000 m^2 (1 module) for special-purpose rice production. Initially, the farm inputs were provided by the project. The farmer-partner provided the expenses for farm labor and other or additional inputs. Technical backstopping was done by technical specialists from CLSU and LGU-Office of the Municipal Agriculturist (OMA).

Assistance in marketing has become a major part of the activity, as a new extension modality through the clustering approach. The farmer partners were organized into local groups within the area to produce a larger volume of products with the desired quality. The cluster was then linked to the market wherein institutional buyers who offered premium prices were tapped as partner buyers. In this approach, there is a sure market with the agreed selling price before the special-purpose rice is planted.

2.1.5. Monitoring and Provision of Technical Assistance

Project monitoring was conducted by the project team simultaneously with the technical assistance and advisory services. This was to find out the status of the project, ensure that the progress was made according to plan, provide timely action in case of problems, and guide the farmers in the setting up and management of demo farms. Activities and results were documented by the team in cooperation with the farmer partners. Technical specialists from the CLSU Research Office (now CRRDC) were tapped to provide technology coaching and mentoring. Field visits combined with phone calls and texting were employed to provide technical assistance and advisory services to the farmer partners.

2.1.6. Conduct of Field Day

The field day was organized to boost public awareness and enthusiasm for innovative technologies, like SPR farming. A single field day was arranged and attended by a total of 49 participants, including farmers, extension workers, and other stakeholders. A field day is an event organized to bring farmers together for a practical, on-site learning experience. It often includes tours of demonstration

plots, interactive sessions, and discussions on best practices. Field days provide a platform for farmers to interact with experts, share experiences, and learn from each other.

2.1.7. Assessment of Project Implementation

Assessment of the project implementation was conducted periodically to evaluate whether the project met its stated objectives and delivered the intended outcomes and to assess its impact on the intended beneficiaries. The assessment was attended by the project team, a representative from the Office of the Municipal/City Agriculturists, and farmer partners.

2.2. Data Gathering and Analysis

2.2.1. Data Gathering

1) Household Profiling

A household survey instrument was prepared and administered through face-to-face interviews to collect baseline data and derive the socioeconomic and demographic profiles of the farmer-partners of the pilot project. The survey instrument was designed to capture relevant information on the socio-demographic attributes of the farmers, encompassing factors such as age, gender, education level, occupation, and income.

2) Focused Group Discussions

Focused group discussions were conducted with the cluster of farmers. These discussions provided a platform for in-depth conversations and exchange of ideas among the farmers. The focus group discussions were structured to obtain their attitude towards special-purpose rice production and to determine the facilitating factors in the adoption of the technology. The participants had the opportunity to share their experiences, perspectives, and insights which helped to determine the best extension modalities that are appropriate for special-purpose rice production adoption. The insights and outcomes from the focused group discussions have been documented and analyzed, providing valuable inputs for decision-making and further improvement of the project.

3) Monitoring and Data Sheet Preparation

In addition to profiling and focus group discussions, monitoring was conducted to obtain other data particular to the productivity and profitability of growing SPR. Data sheets were prepared and distributed to the farmer-partners. This data sheet served as a tool to document their observations as well as record various direct and indirect costs associated with SPR production. These costs include expenditures on farm inputs such as fertilizers, seeds, and pesticides. Labor and other items. In addition, the sheet provided data on sales and quantity of production.

2.2.2. Methods of Analysis

The demographic and economic analysis was analyzed using descriptive statistics of key measures, such as mean, standard deviation, range, and percentages. The cooperator's level of knowledge of special rice farming was determined through a survey questionnaire that was administered before and after the training. Data

were analyzed and described through a five-point Likert scale. Moreover, the farmers' attitudes towards special rice farming were described through percentages before and after the training.

The number of farmers and the area planted with SPR, the harvest report, and the economic analysis were measured and described in terms of average and return on investment and benefit-cost analysis. These measures were employed to provide a summary and descriptive analysis of the data.

2.3. Ethical Consideration

Farmers provided informed consent, while privacy safeguards protected their personal information. Precautions ensured no harm from treatments and technologies. Operations were adjusted to suit farmer' needs while respecting their culture and individuality. The project engaged stakeholders, including communities, businesses, and governmental organizations, from conception to evaluation. Sustainability and scalability were considered. The project team's commitment to ethical principles and responsible practices aimed to benefit farmers, communities, and the environment, creating lasting positive impacts.

3. Discussion of Results

Pilot Project Establishment

Table 1. Model farm established during the pilot promotion of SPR production project in dry season 2021.

Municipality/City	No. of Model Farm (MF)	No. of Farmer-partners	Area Planted (ha)	$Percent_{MF}$
Talavera	5	5	1	45.45
Science City of Muñoz	6	6	1.2	54.54
Total	11	11	2.2	100

After a successful social preparation phase, the pilot project promoting special-purpose rice production established eleven model farms, managed by eleven farmer partners, during the dry season of 2021. Among these, five farmer partners from Talavera, representing 45.45% of the group, cultivated a total of 3.6 hectares, while six partners from the Science City of Muñoz, or 54.54%, planted 1.7 hectares. To guarantee that the farmers were adequately prepared for this endeavor, they participated in extensive training in production technology and enterprise management. Every participant was provided a start-up kit that entails standard farm inputs like improved seeds for special-purpose rice developed by CLSU, quality fertilizers for improving the fertility of the soil, and growth hormones to improve the growth of the plant. The production support and technical intervention were very helpful, especially in helping the farmers as they set up a pigmented rice production system by providing farmer partners with technical information as well as resources for improving their yields and

implementing pigmented rice production cultural management practices. The provisions were received by the farmers across both partner municipalities, ensuring that all participants benefited equally from the support and resources provided, fostering a collaborative environment for successful special-purpose rice production (Table 1).

Socio-Demographic and Economic Profile of the Farmer-partners

The farmer-partners' socio-demographic and economic profile is summarized in Table 2.

Sex

Of the 11 farmer-partners, 7, or 64% were male. This reflects a general scenario in the Philippines which shows that agriculture predominantly involves men which in turn, is attributed to the physical nature of the work in the sector. There are significantly more male farmers than females in the Philippines, with men comprising around 77% of the agricultural workforce [5]. This male dominance in Philippine agriculture has persisted for a long time. The study of Ani and Casasola, 2020 is related to the study of Mishra *et al.*, 2017 which revealed that rural women are involved more intensively in agricultural work than men. However, female-headed farm households are less efficient in farming.

Age

The average age of the farmer-partners was 60 years. This is consistent with the study by the Philippine Center for Post-Harvest Development and Mechanization (PhilMech) in 2014 [6] the farmers are above 40 years old and a high percentage of farmers aged 60 and above were noted in Camarines Sur and Iloilo. This affirms one major concern in the sector being that of an aging population. Reports have mentioned that an aging farming population threatens the country's food security because of its effect on agricultural productivity. In this scenario, experts predict the Philippines will face a critical shortage of farmers in 10 - 12 years.

Marital Status

Except for one, all of the farmers-cooperators (10 or 91%) were married at the time of the survey. This shows that the farmers have families of their own and thus are persons of responsibility.

Educational Attainment

Educational levels vary among the farmer-partners, with no individuals lacking formal education. A majority (55%) of the farmers were college graduates. This means that the farmer-partners could easily be taught about new agricultural technologies and be expected to teach the same to other farmers. Farmers are important agents of technology dissemination because they are relatable and accessible to other farmers in the communities.

Occupation

As expected, all of the farmer-partners (11 or 100%) claimed that their primary source of income was farming. This could be one reason they were interested in improving their enterprise.

Monthly Source of Income

Many of the farmers were earning below 12,000.00 (5 or 46%) during the time

of the interview. This shows that they are living below the Philippine poverty threshold of 2022 which is P12,030 per month for a family of five [7]. However, 3 or 27% of the farmers are earning between 12,000.00 and 20,000.00. On average, each farmer-co-operator earns 17,880.14 per month.

Table 2. The farmer-partners' socio-demographic and economic profile.

Profile	Frequency (n = 11)	Percentage (%)
Sex		
Male	7	64
Female	4	36
Age (Years)		
41 - 50 yrs. old	1	9
51 - 60 yrs. old	5	46
61 - 70 yrs. old	4	36
71 - 80 yrs. old	1	9
Mean: 60		
SD: 7.79		
Range: 40 - 75		
Marital Status		
Single	0	0
Married	10	91
Widow	1	9
Educational Attainment		
College Graduate	6	55
College Level	3	27
Vocational	0	
High School Graduate	2	18
High School Level	0	
Elementary Graduate	0	
Primary Source of Income		
Farming	11	100
Government Employment	0	0
Gross Monthly Income		
Below 12,000.00	5	46
12,000.00 - 20,000.00	3	27
20,001.00 - 28,000.00	0	0
28,001.00 - 36,001.00	1	9
36,001.00 - 44,000.00	1	9
44,001.00 - above	1	9
Mean: 17,880.14		
SD: 14,474.46		

Knowledge Level of Farmers-Partners Before and After the Training

Pre- and post-tests were conducted to determine the farmer-partners' level of knowledge of special rice farming before and after the training. Instruments were formulated and used for the pre- and post-tests. The instruments contained the various steps involved in rice farming and farmers were asked to rate their level of knowledge on a five-point Likert scale, with "1" being the lowest and "5" being the highest. Table 3 summarizes the results.

As shown in Table 3, the farmers' level of knowledge of the steps in special rice farming ranged from "Low" to "Moderately High" before attending the training. After the training, their knowledge level ranged from "High" to "Very High." On the whole, the farmers' knowledge level was "Moderately High" (Mean = 2.69) before the training. It became "High" (Mean = 4.17) after the training. The results suggest that there was an improvement in the participant's level of knowledge after the training. This indicates that the training was effective in teaching the farmers about special rice farming.

Table 3. Farmers' level of knowledge of special rice farming.

Knowledge Before the Training	Mean	Dec.	Knowledge After the Training	Mean	Desc.
1) Soil selection	2.58	L	1) Soil selection	4.08	H
2) Seedbed preparation	3.50	H	2) Seedbed preparation	4.17	H
3) Seed germination	2.33	L	3) Seed germination	3.75	H
4) Seeding	3.33	MH	4) Seeding	4.42	VH
5) Land preparation	3.50	H	5) Land preparation	4.67	VH
6) Transplanting	3.33	MH	6) Transplanting	4.75	VH
7) Water management	2.00	L	7) Water management	4.42	VH
8) Nutrient management	2.00	L	8) Nutrient management	4.00	H
9) Pest and disease management	1.92	L	9) Pest and disease management	3.50	H
10) Weed management & rouging	2.08	L	10) Weed management & rouging	3.58	H
11) Harvesting	3.00	MH	11) Harvesting	4.58	VH
Mean	**2.69**	**MH**		**4.17**	**H**

Legend: Level of Knowledge	Description
4.21 - 5.00	Very High (VH)
3.41 - 4.20	High (H)
2.61 - 3.40	Moderately High (MH)
1.81 - 2.60	Low (L)
1.00 - 1.80	Very Low (VL)

Attitudes of Farmer-Partners Toward Special Purpose Rice Production

The farmers were asked to answer some statements to assess their attitude towards special-purpose rice farming. As shown in Table 4, more farmers (7 or 63.6%) were uncertain regarding the potential of special rice farming before

undergoing the training. This was probably because they knew little about special rice before this. After the training, most farmers (8 or 72.7%) believed in the potential of special rice farming.

Table 4. Farmers' attitude towards special rice farming.

Statement	Before the Training		After the Training	
	Frequency (n = 11)	%	Frequency (n = 11)	%
Special rice farming has a high potential				
Yes	4	36.4	8	72.7
Maybe	7	63.6	3	27.3
No				
Special rice farming is complex				
Yes	6	54.5	1	9.0
Maybe	5	45.5		
No			10	91.0
I am interested in trying special rice				
Yes	5	45.5	9	81.8
Maybe	6	54.5	2	18.2
No				

Productivity of Special Purpose Rice Farming

Table 5 provides the harvest report of special-purpose rice farmers from 2021-2023. The table shows that the average harvest of farmers increased by 5.41 MT, 6.07 MT, and 6.86 MT during the dry seasons of 2021-2023, respectively. This reveals the potential yield of the variety as the farmers have followed production protocols and further adapted some production techniques and practices. In addition, access to and availability of quality seeds is also an important factor in the production of a significant quantity and quality harvest. Quality seeds are a crucial input to attain the potential yield of a particular crop [8]. Furthermore, the increase in production indicates their improved skills in SPR farming. The highest average yield of CLS-2 (pigmented) per hectare was 6.86 MT during the dry season of 2023. On average, the CLS-2 variety yields 6.11 MT per hectare during the dry season from 2021-2023. Its yield is higher than that of the usual inbred varieties of rice like NSIC Rc 160 (5.6 MT/ha), NSIC Rc 216 (6 MT/ha), NSIC Rc 218 (3.8 MT/ha), and NSIC Rc 222 (6.1 MT/ha) according to Madrid *et al.*, 2021. This data is reinforced by the Rice Data Analytics Dashboard (2022) where Nueva Ecija has an average yield of 6.08 MT/ha for the year 2022.

On the other hand, the highest average yield during the wet season was 5.92 MT/ha in 2022. However, the three-year (2021-2023) average yield, 5.04 MT/ha, was lower when compared with an average yield of 5.5 MT/ha (NSIC Rc222) and 4.9 MT/ha (PSB Rc18) [9]. In general, lower yield is expected during the wet

season compared to the dry season due to lower and shorter light radiation from the sun, particularly during flowering and filling of the grains (Yang *et al.*, 2008).

Table 5. Harvest report of special purpose rice, 2021-2023.

Municipality/ City	Variety	DS 2021		WS 2021		DS 2022		WS 2022		DS 2023		WS 2023	
		Area (ha)	Yield (MT)	Area (ha)	Yield (MT)	Area (ha)	Yield (MT)	Area (ha)	Yield (MT)	Area (ha)	Yield (MT)	Area (ha)	Yield (MT)
Talavera	CLS-2	1	5.37	1	4.49	3.6	20.43	3.6	20.15	1.8	11.15	1.6	7.15
Science City of Muñoz	CLS-2	1.2	6.54	1.2	5.61	1.7	11.75	1.7	11.25	3.2	23.15	14.2	65.69
Total		2.2	11.91	2.2	10.10	5.3	32.18	5.3	31.40	5	34.30	15.8	72.83
Average (MT/ha)			**5.41**		**4.59**		**6.07**		**5.92**		**6.86**		**4.61**

Average: Dry season (2021-2023): 6.11MT; Wet season (2021-2023): 5.04 MT.

Profitability of Special Purpose Rice Farming

Table 6 shows the cost and return analysis of special purpose rice production (CLS-2) for the clustered farmer-partners from 2021-2023. It displays the summary of the gross income, total expenses, net income, return on expenses, and average cost of production per kilogram of SPR for six cropping seasons. The income from the SPR by the farmer-partners depends on the area planted. However, it was computed on a hectare basis for ease of discussion and better visualization. The gross income from selling dry CLS-2 variety of palay ranges from Php 99,333.33 to Php 155,914.00 per hectare with a net income that ranges from Php 44,415.52 to Php 84,913.66. This is higher compared to selling dry inbred palay with a gross income that ranges from Php 89,869.82 to Php 118,043.90 and a net income that ranges from Php 27,572.82 to Php 56,317.40 per hectare, respectively (Table 7). In addition, the average production cost per kilogram of dry SPR ranges from Php 11.38 to Php 13.82 for the six cropping seasons (2021-2023). It is a little bit higher in producing a kilogram of dry inbred palay that ranges from Php 11.17 to Php 11.98 as computed based on the data [10]. However, the income from planting SPR is still higher than planting regular or inbred rice because the selling price of dry SPR is higher (Php 25/kg) than the price of dry inbred palay ranging from Php 17.28 to Php 21.36 for the years 2021-2023.

For the six cropping seasons, the return on investment in producing SPR ranges from 80.88% to 119.6%. This means that for every peso spent by the farmer, the return ranges from Php 0.81 to Php 1.20. This indicates that the investment is highly profitable. Moreover, the average cost of production per kilogram of dry SPR is lower than the selling price of Php 25.00. This means that less money is spent to produce a kilogram of SPR and represents a positive profit margin. It also indicates that the enterprise is profitable on each kilogram sold.

The selling price of Php 25.00 per kg of dry palay is the result of the negotiations between farmer clusters (facilitated by the project team) and the institutional buyer. During the negotiation, the buyer and the cluster have agreed on the quantity and expected quality and availability of produce to be provided by the cluster

members. Through this transaction, both parties have guarantees of the benefits that can be obtained from SPR farming, particularly supply and income.

Table 6. Cost and return analysis of special purpose rice CLS-2 variety per hectare.

Particular	2021		2022		2023	
	Dry	Wet	Dry	Wet	Dry	Wet
I. Gross Income	**123,016.25**	**102,511.25**	**135,515.50**	**131,058.00**	**155,914.00**	**99,333.33**
Number of Cavans	98.00	82.00	108.00	104.00	124.00	79.00
Yield (kg, dry)	4920.65	4100.45	5420.62	5242.32	6236.56	3973.33
Price per kg	25.00	25.00	25.00	25.00	25.00	25.00
II. Expenses						
A. Operating Expenses						
1. Labor						
Seedbed preparation	1532.05	1500.00	1747.75	1460.18	1365.85	1500.00
Land Preparation	2878.21	3500.00	4016.52	5318.58	5560.98	3928.57
Crop Establishment	6611.54	8368.29	9036.04	9707.08	8851.22	9009.52
Chemical Application	525.64	1024.39	780.78	1106.19	1073.17	-
Drying	980.00	1640.00	1296.00	2496.00	1860.00	2370.00
Porcientuhan (10%)	12,301.63	10,251.13	13,551.55	13,105.80	15,591.40	9,933.33
Harvesting (10%)	12,301.63	10,251.13	13,551.55	13,105.80	15,591.40	9,933.33
Total Labor Cost	**37,130.69**	**36,534.93**	**43,980.18**	**46,299.64**	**49,894.02**	**36,674.76**
2. Material Inputs						
Seeds	1400.00	1360.00	1440.00	1420.00	1520.00	1480.00
Fertilizers	18,130.77	14,219.51	18,774.77	10,949.56	14,500.88	14,552.38
Pesticides	1782.05	1451.22	3319.07	1031.33	1619.35	1309.52
Fuel	2560.50	658.45	2922.52	735.73	2195.12	444.00
Other expenses	1350.00	702.44	714.71	1737.17	1270.98	457.14
Total Material Cost	**25,223.32**	**18,391.62**	**27,171.08**	**15,873.78**	**21,106.32**	**18,243.05**
III. Total Expenses	**62,354.01**	**54,926.55**	**71,151.26**	**62,173.42**	**71,000.34**	**54,917.81**
IV. Net Income/Loss	**60,662.24**	**47,584.70**	**64,364.24**	**68,884.58**	**84,913.66**	**44,415.52**
V. Return on Expenses ROE (%)	**97.29**	**86.63**	**90.46**	**110.79**	**119.60**	**80.88**
VI. Average Production Cost (P/kg)	**12.67**	**13.40**	**13.13**	**11.86**	**11.38**	**13.82**

To determine the benefits of farmer-partners in producing SPR, their income from yield was determined and compared to the income from producing regular rice. As shown in Table 7, the farmers have an average net benefit of Php 61,804.16 from producing SPR over three years or six cropping seasons. This is higher compared to planting regular rice with an average net benefit of Php 39,448.63. This showed that planting SPR over regular rice benefits the farmer-partners with an

additional income of Php 22,355.53 per hectare for three years. This finding is supported by the results of the study on the promotion of special rice production to boost the income of rice farmers [11].

The average production cost (Php 62,753.90) of SPR is a little bit higher than the production cost (61,726.50) of regular rice. However, the net benefit is much higher for producing SPR due to the higher (Php 25) market price of a dry basis compared to regular rice which ranges from Php 17.28 to Php 21.36 from 2021-2023 [10]. The acquired special price of SPR is a result of market linkage as part of the enterprise development effort of the project team.

Table 7. Benefit-cost analysis of special purpose rice production.

Particular	SPR (CLS-2)				Regular Rice*			
	2021	2022	2023	Average	2021	2022	2023	Average
Benefit	112,763.75	133,286.75	127,623.67	124,558.06	89,869.82	95,611.65	118,043.90	101,175.13
Cost	58,640.28	66,662.34	62,959.08	62,753.90	62,297.00	61,156.00	61,726.50	61,726.50
Net Benefit	54,123.47	66,624.41	64,664.59	61,804.16	27,572.82	34,455.65	56,317.40	39,448.63
Difference				61,804.16 - 39,448.63 **22,355.53**				

*Source: https://www.philrice.gov.ph/ricelytics/main/province.

Facilitating Factors for the Adoption of Special Purpose Rice Technology

The facilitating factors for the adoption of SPR technology are shown in Table 8. A set of survey questionnaires was prepared and administered to determine the reasons why the farmers have adopted the SPR production technology. The set of questions or statements indicating the facilitating factors were categorized into five. The respondents' scores were computed through their weighted average and ranked with description. The table shows that the average score of the facilitating factors under the five categories was described as "moderately high (MH) to very high (VH). Based on the results of the survey, the marketing and entrepreneurship category ranked as number 1 with an average score of 4.3 (VH) and the "higher/premium price" with a highest weighted average score of 4.91 as the first or highest reason why they adopted the technology. This indicates that the presence of a market that offers premium prices, market awareness brought about by the clustering activities, and the opportunity to increase income through value addition are the most important factors that farmers have considered in adopting the technology. The marketing interventions executed via the Agro Enterprise Clustering Approach (AECA) are crucial for improving the sustainability of rural enterprises and the project as a whole. In so doing, these initiatives establish a conducive environment for the development of special-purpose rice (SPR) enterprises, which remove marketing risks such as arbitrary and unpredictable market prices. This stability can augment farmers' incomes and encourage long-term commitment to the project, sustainable rural-based enterprise, and profitable agricultural practices.

Moreover, the AECA promotes collaboration among farmers, producers, and marketers, thereby fortifying community connections and augmenting collective bargaining power. This collaborative strategy facilitates farmers' adaptation to market demands and trends, thereby fostering innovation and resilience in rural economies. The marketing interventions provide farmer partners with immediate financial advantages while promoting the primary goal of sustainable rural development.

The institutional category came in second place among the facilitating factors. This is mostly because of the "provision of start-up kits" that are given to new farmer partners after they finish training on SPR technology. These kits, which come with good seeds and fertilizer, are very important for getting people to use Special Purpose Rice (SPR). Notably, "Financial Status/Level of Income" got a low score of 2.55, making it the least important factor affecting adoption. This shows that farmers who don't have a lot of resources are still willing to use SPR technology because there are strong support systems in place.

The program's openness, targeted training, and the fact that successful adopters were visible in the community all helped to build trust and encourage participation. This shows how important institutional support and market incentives are for getting around financial problems so that these farmers can make SPR production a viable business. In the future, efforts should be made to keep access open and give more money to farming communities that are struggling.

Table 8. Facilitating factors for the adoption of special purpose rice.

Category	No.	Facilitating Factors	Score	Weighted Average	Average	Rank & Description
Marketing and Entrepreneurship	1	Market awareness and better market opportunities	53	4.82	4.30	1 (VH)
	2	Opportunity for value addition	35	3.18		
	3	Higher/premium price	54	**4.91**		
Institutional	1	Provision of training and clustering	44	4.00	4.18	2 (H)
	2	Provision of technology protocols and technical assistance	45	4.09		
	3	Provision of start-up kits	49	**4.45**		
Technological	1	Accessibility of the technology	51	**4.64**	3.91	3 (H)
	2	The relative advantage of the technology	27	2.45		
	3	Compatibility to the existing practices	51	**4.64**		
Environmental	1	Favorable climatic condition	35	3.18	3.09	4 (MH)
	2	Favorable soil condition	31	2.82		
	3	Availability of water	36	**3.27**		
Socio-Economic	1	Educational attainment	32	2.91	3.06	5 (MH)
	2	Financial status/level of income	28	**2.55**		
	3	Farm size and availability of resources	41	3.73		

Range	Description
4.21 - 5.00	Very High (VH)
3.41 - 4.20	High (H)
2.61 - 3.40	Moderately High (MH)
1.81 - 2.60	Low (L)
1.00 - 1.80	Very Low (VL)

The Ripple Effect of the Pilot Promotion

Table 9 shows the summary of the area planted with SPR and the number of adopters during the pilot promotion of the technology within three years. A total of eleven (11) farmer-partners have started to establish model farms with a total area of 2.2 hectares as a showcase of the technology during the dry season of 2021. They were organized into two clusters and then linked to institutional buyers to obtain premium prices. The number of adopters was maintained and 3 more farmers adopted the technology during the two cropping seasons of 2022. This reflects the general type of adopters as the "early majority" whose characteristics are "to see is to believe" and who will adopt a technology or practice only if convinced of its value.

Table 9. Summary table of area planted with special purpose rice and number of adopters per cropping season.

Cropping Period	No. of Farmer-Adopters	Additional Farmer-Adopters	Area Planted with SPR (ha)	Yield (MT)	Yield per ha (MT)
Dry Season 2021	**11**	0	**2.2**	11.91	5.41
Wet Season 2021	11	Maintained	2.2	10.10	4.59
Dry Season 2022	11	Maintained	5.3	32.18	6.07
Wet Season 2022	15	3	5.3	31.40	5.92
Dry Season 2023	15	Maintained	5	34.30	6.86
Wet Season 2023	**34**	**23**	**15.8**	72.83	4.61
Mean	*16.17*		*5.97*	*32.12*	*5.58*
% Increase	***209***		***618***		

After three years of promotion, 34 farmer-partners have adopted the technology, equivalent to a 209% increase in the number. The area planted with SPR has also increased from 2.2 hectares to 15.8 hectares, equivalent to a 618% increase. These increases in the number of adopters and areas planted were attributed to the extension activities conducted by the project team mentioned in the methodology. Aside from those activities, other farmers have adopted the technology due to the following reasons:

a) They have seen the model farms and become interested;

b) Promoted by fellow farmers; and

c) Attended farmer meetings held by their organization and understood and was convinced by the process within the cluster; and

At present, an additional five municipalities have joined the Techno Village Development Program namely Lupao, Guimba, Zaragosa, Aliaga, and Cuyapo, all in Nueva Ecija. One organization in Lupao is now processing SPR into brown rice using a dehulling machine from the Department of Agriculture. Through the involvement of farmer-partners to value value-adding like processing, SPR producers are guaranteed to have market demand for their products aside from paddy rice. This will enable them to produce more or expand their production area and may encourage additional farmers to plant special-purpose rice. Thus, sustainable adoption of the technology is achieved.

4. Conclusions

The study focused primarily on the socioeconomic and agribusiness aspects of Special Purpose Rice (SPR) production, to increase farmers' income and adoption through various promotion, training, and enterprise development initiatives. It describes the farmers' socio-demographic profile and the extension modalities that were used to increase income and technology adoption rates. While aspects of soil and water conditions in the farm location were taken into account during the site selection, the study did not include the assessment of the overall environmental impacts such as water consumption, application of fertilizers, and state of the soil. These aspects could be areas for further research to complement the findings and promote sustainable SPR production.

Based on the results of the activities and interventions, the following conclusions were drawn:

1) The farmer-partners are aging farmers with an average age of 60 years old and rice farming as their primary source of income;

2) The farmer-partners' level of knowledge on SPR production has increased from moderately high to high after the training;

3) The farmer-partners' attitude towards SPR production has improved as the majority of the farmers expressed belief in the potential of SPR farming after the training;

4) Significantly higher income can be realized in SPR farming compared to regular rice farming;

5) The adoption of the SPR technology has significantly increased due to marketing and entrepreneurial development activities complemented with extension activities as intervention by the institution; and Start-up kits, particularly the seeds, should be of high quality.

5. Recommendations

Given the results obtained in this study, the following are recommended:

1) Broaden Market Opportunities: Proactively identify and interact with supplementary institutional purchasers to foster a competitive market landscape for SPR product lines from grain to process products. This strategy will expand the price differential between Special Purpose Rice (SPR) and conventional rice, thereby enhancing profitability for farmers and promoting ongoing adoption.

2) Strengthen LGU linkages: Enhanced the collaboration with LGUs entitled to allocation and budget appropriations by mainstreaming the SPR projects within the agricultural development programs in the municipality. It will ensure that the adoption of SPR is sustainable and in line with local priorities in local agriculture.

3) Research and Development: Provisions have to be made for research and development instituting new varieties of SPR which increase yields without compromising on quality, which is also on par with international markets. This plan must include breeding programs that help plants resist diseases, pests, and tough weather while still keeping the great qualities of SPR. In addition, research should focus on assessing broader environmental factors such as water use, fertilizer use, and soil health. This is essential for sustaining SPR production that contributes to the enterprise.

Author Contributions

Each author made equal contributions to the study's conceptualization and design. All authors have reviewed and approved the final version of the manuscript for publication.

Funding

This research was funded by the Central Luzon State University under its regular extension fund 101.

Acknowledgements

The project team and authors would like to express their sincerest gratitude to the CLSU President and Vice President for Research and Extension for funding the program. They also would like to acknowledge CRRDC as a technology generator and its experts for providing technical assistance during the conduct of the project and study. The Municipal Agriculturists and LGU staff for their significant contribution, and the farmer-partners for their unwavering support.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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