Philippine Journal of Crop Science (PJCS) August 2025, 50 (2): 80-88

https://doi.org/10.63568/pjcs.v50i2.1535

RESEARCH NOTE

Spatial Patterns, Farmer Practices, Rice Yield, and Socio-Economic Profile of Triple-Rice (*Oryza sativa* L.) Monocropping in the Bago River Irrigation System, Negros Occidental, Philippines

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The triple-crop rice monocropping system is commonly practiced in areas covered by the Bago River Irrigation System (BRIS) in Negros Occidental, Philippines. The study aimed to assess the spatial extent of triple-rice cropping in the province and BRIS and evaluate farming practices, rice yield, and the economic status of local farmers to identify information needs and challenges. Maps generated accounted for 90% accuracy, and results showed that Bago City and Valladolid had the largest third-crop rice areas. A survey was conducted with 240 farmer respondents from six Irrigators' Associations (IAs) of BRIS, using stratified sampling, providing a 95% confidence level with a 5% margin of error. The survey revealed that 93.3% of farmers grow five rice crops every two years or practice one to two rice crops per year, while 4.6% plant rice in all three cropping seasons over the two years. Early-maturing rice varieties and direct-seeding methods were commonly used by farmers to shorten the cropping period per season, enabling the triple-crop system. The study's objectives aimed to provide insights that can guide sustainable farming practices, improve policy decisions, and support increased rice production capacity to address the food security issues in the region.

Keywords: crop intensification, monocropping, multiple cropping, rice production, triple-rice crop production pattern

INTRODUCTION

Globally, one of the challenges facing the agricultural sector is increasing crop production to meet the rising demand for food due to population growth. Various methods to achieve this include expanding the area of standing croplands and enhancing crop yields through agricultural intensification on existing croplands, as emphasized by Ray and Foley (2013). Their study demonstrated that the annually harvested cropland increased faster than the total standing cropland. In recent decades, raising cropping intensity has significantly contributed to the surge in global food production. Multiple cropping or intensification is a system in which crops are harvested more than once a year on the same land or standing cropland (Dalrymple, 1971). This can occur in systems with multiple harvests of the same crop or with a more diverse approach, where different types of crops are grown simultaneously or in a sequence. Quick turnaround (QTA) refers to a system where planting occurs immediately or "quickly" after harvest. This system is characterized by a short turnaround period (i.e., the number of days between harvest and the next planting). Common traits of QTA systems include using direct seeding (wet and dry) as a crop establishment method, planting early maturing rice varieties, having no fallow period, and ensuring access to a sufficient and reliable water supply. The QTA system has been adopted and practiced by many rice farmers in different parts of the Philippines. A key feature of the QTA system in rice is the ability to grow three crops per year.

Western Visayas (Region VI) ranks third among the largest rice-producing regions in the country. According to the PSA (2019), the region recorded 626,701 hectares of rice harvested, with an average yield of 3.25 tons per hectare. Despite technological breakthroughs in rice research, farm yield levels remain significantly below their maximum potential. Nevertheless, the region has managed to boost productivity by intensifying rice cropping. This increase in cropping intensity is supported by the irrigation program strategies from the National Irrigation Administration (NIA) as part of the Food Staples Sufficiency Program (FSSP), focusing on adapting to five crops in two years or three rice crops per year (www.nia.gov.ph). Adopting three cropping seasons annually has been recommended for rice areas with high rainfall and reliable irrigation. Several farmers in Western Visayas adhere to the three-cropping-per-year practice, even in rainfed areas. In Negros Occidental, 55% or 21,866.63 hectares of irrigated rice area are planted with three rice crops, while 27% or 11,816.91 hectares in Iloilo follow the same practice (DA-RFO VI, 2019).

Bago City, Negros Occidental, is one of the key rice-producing districts in Western Visayas. It has guaranteed irrigation facilities through the Bago River Irrigation System (BRIS), which serves the largest area in the province. BRIS serves two cities: Bago City and La Carlota City, and three municipalities: Valladolid, Pulupandan, and Murcia. Quick

Turnaround systems, which typically involve multiple rice harvests within a year, include triple rice cropping, where rice is planted and harvested three times annually, and five crops over two years. These high-intensity systems are continuously implemented in Bago City (Pintor et al., 2023). While five crops over two years average 2.5 crops per year, they are considered slightly less intensive than continuous triple cropping.

A spatial analysis was conducted to determine the scope and extent of triple rice cropping. A survey was carried out to examine variables related to agronomic practices, rice yield performance, and the socio-economic dynamics of farmers in BRIS employing triple-rice cropping systems. Documenting and analyzing the QTA system to understand how it operates within the rice agroecosystem and identifying its socioeconomic impact will provide an overall understanding of its production advantages, opportunities, constraints, and gaps. Additionally, it will help determine the technical constraints faced by farmers, such as their access to and use of seeds, water, nutrients, pest management, soil, and knowledge. The results can be used to identify the harvest gap between the maximum theoretical harvest frequency and the existing harvest frequency in the locality and the yield gap between the potential threshold and the actual yields achieved by farmers.

METHODOLOGY

Map Generation

The study was conducted from January 2021 to December 2023 in Negros Occidental, Philippines. Available rice maps, the start-of-season map, field data, and secondary information from reliable sources were utilized to generate the spatial information on the third crop rice. Rice area and start-of-season raster files from 2021-2022 were obtained from the Philippine Rice Information System (PRISM) through the online data request portal of the project (prism.philrice.gov.ph/infolib/). Raster files were reprocessed using Quantum GIS (QGIS) software to identify the planting dates of the rice areas within the province. Planting dates from secondary data, which coincided with actual planting periods, were used to pre-identify third crop rice. The pre-identified third crop rice was validated using 100 ground data points collected during the peak of planting of third crop rice. The accuracy of the validated third crop rice was assessed using the standard confusion matrix. The generated validated third crop rice was labeled and laid out in QGIS by overlaying shapefiles of regional, provincial, and municipal boundaries for better visualization of the rice area boundaries.

Survey Sampling Procedure and Analysis

The NIA-Negros Occidental provided a list of Irrigators' Association (IAs) along with the number of registered farmer-members. Using the list, a stratified sampling technique was employed to select farmer-respondents, ensuring representation from different geographic and positional strata of BRIS. A total of six IAs were selected: three upstream and three downstream of the BRIS. These Irrigators' Associations are geographically distributed, with

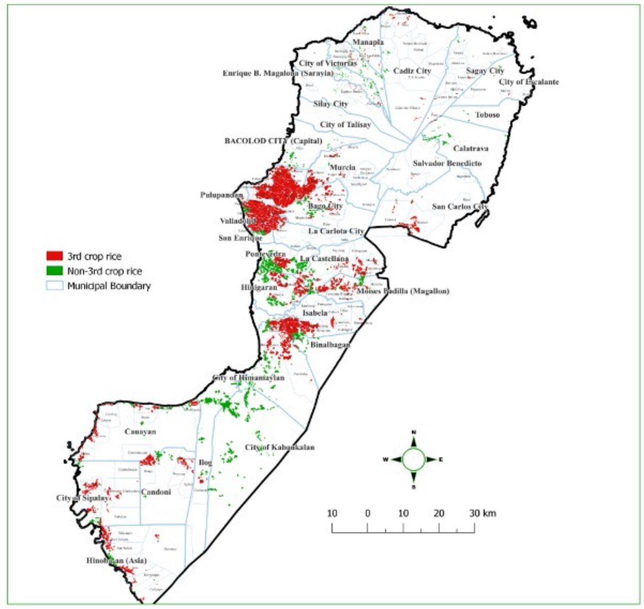

Figure 1. Spatial presentation of third-crop rice in Negros Occidental. (Year 2023)

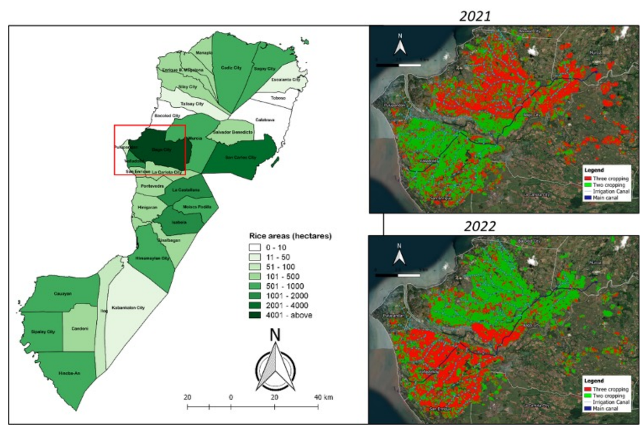

Figure 2. Map showing the rice areas planting three crops in the years 2021 and 2022 in the Bago River Irrigation System using the PRISM start of the season (SOS) map.

upstream groups located in the northern part of the irrigation system and downstream groups in the southern part. This stratification allowed for an analysis of potential differences in access, usage, and outcomes relative to their position within the irrigation system. The farmer respondents from IAs in the north of the BRIS are Camingawan Cabanbanan (CAMICABA), Sumbingco Marañon Cabarles West Way Irrigators' Association (SUMACAWE), and Tabunan-Taloc. Meanwhile, the IAs in the south of the BRIS include Mabini Palaka, Caridad-Alianza, MC HAMUNGAYA. The required sample size was computed using the following formula: $n' = n/(1+((z^2 x \hat{p}(1-\hat{p}))/(\varepsilon^2 N)))$; where z is the z-score, ε is the margin of error set as 5%, N is the population size (863 farmer members of the six IAs), and $\hat{p}$ is the population proportion set as 50%.

Forty farmers were randomly selected from each IA, accounting for a total of 240 out of 863 farmers who served as study respondents. This sample size corresponds to a 95% confidence level with a 5% margin of error. Farmer respondents were then randomly selected from each IA's membership list using simple random sampling, ensuring each member had an equal chance of being included in the study.

A survey instrument was used, consisting of the following sections: (1) rice cropping system; (2) variables related to rice productivity; (3) seeds and varieties; (4) crop management practices of farmers; (5) access to technologies and information; and (6) socioeconomic profile and profitability. Crop management practices include the rice cropping system, varieties used, land preparation, crop establishments, nutrient and pest management, and harvest and post-harvest management. Descriptive statistics such as frequency counts, totals, and percentages were used to describe survey data. Box plot analysis was used to describe yield data and fertilization rates.

RESULTS

Coverage of Triple-Rice Cropping System

In Negros Occidental, the third cropping of rice is very common throughout the province, as shown in Figure 1. Bago City and Valladolid have the largest third-crop rice areas, followed by Isabela. These rice areas are irrigated, with Bago City and Valladolid supplemented by BRIS. Bago City has the largest physical rice areas in the province, as shown in Figure 2. The rice areas covered by BRIS are grouped into north and south. The north and south are alternately scheduled for either three or two rice crops per year by the NIA. In 2021, the north implemented three rice crops, while the south implemented three rice crops in 2022. Although the rice cropping intensity in BRIS is five crops over two years, some farmers still implement three rice crops per year, or six rice crops over two years. These are the rice areas with three crops in the south in 2021 and the north in 2022.

Survey Data of the Start of Season Rice Planting of BRIS

The peak planting season for the three-rice cropping cycle in the south is January for the first crop, May for the second crop, and September for the third crop, except the CAMICABA, which is one month later (Figure 3). The peak of harvest for the January planting will be in April (first crop), August for the May planting (second crop), and December for the September planting (third crop). The peak planting season for the north is February for the first crop, June for the second crop, and October for the third crop, except the MC HAMUNGAYA which is one month earlier. February planting will be harvested in May, June planting will be harvested in September, and October planting will be harvested in January. The north is more synchronous than the south, while the planting schedules for Mabini Palaka and Caridad-Alianza are scattered throughout the year.

Rice Cropping System

Of the 240 respondents, the majority (93.3%) reported cropping five times every two years of rice cultivation

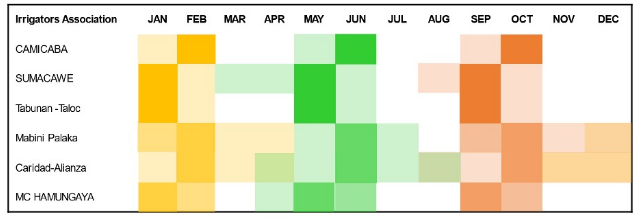

Figure 3. Start of the season rice planting of the third-crop schedule of the farmer respondents from the six Irrigators Associations in Bago River Irrigation System (BRIS):
( ) 1st cropping; ( ) 2nd cropping; and ( ) 3rd cropping; with a lesser gradient for low-frequency counts and a broader gradient for high-frequency counts. (Year 2021)

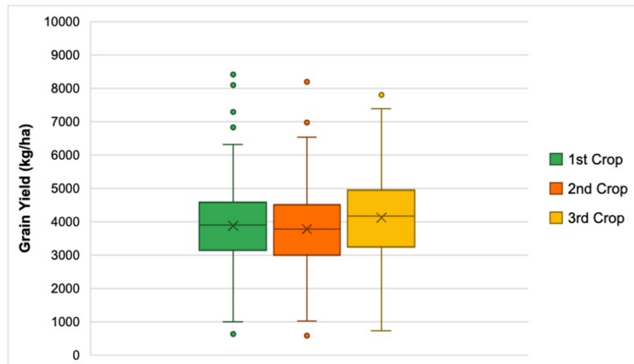

Figure 4. Rice grain yield (kg/ha) of the respondents in Bago River Irrigation System:
( ) 1st cropping; ( ) 2nd cropping; and ( ) 3rd cropping. (Year 2021)

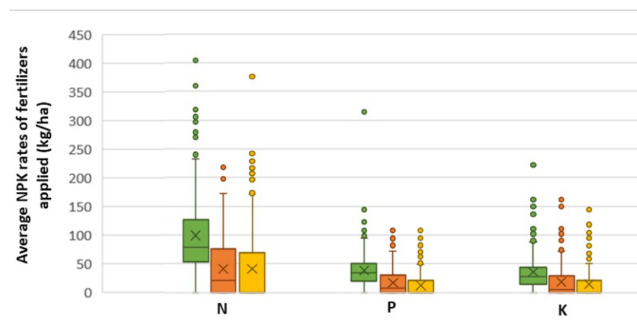

Figure 5. Average NPK rates (kg/ha) of the respondents in Bago River Irrigation System:
( ) 1st cropping; ( ) 2nd cropping; and ( ) 3rd cropping. (Year 2021)

(Table 1). A few cropped three times per year (4.6%), and a very small number cropped twice per year (2.1%). The majority followed a rice-rice-rice cropping pattern (97.5%), with a very small number following rice-rice-ratoon rice (1.25%) and rice-rice-other crops (1.25%). These other crops include mungbean, watermelon, and tomato. Almost one-third did not practice fallow periods (32.1%). Among those who did practice fallow periods, the majority practiced fallow periods after the second crop (77.9%) and had a one-month fallow period (77.9%).

Rice Yield

Rice grain yields of the third crop are slightly higher than those of the first and second crops (Figure 4).

Table 1. Rice cropping system of the respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Frequency of rice cropping	**n=240**	
Two per year	5	2.1
Three per year	11	4.6
Five per two years	224	93.3
Total	240	100
Cropping pattern	**n=240**	
Rice-Rice-Rice	235	97.5
Rice-Rice-Ratoon rice	2	1.25
Rice-Rice-Other crops	3	1.25
Total	240	100
Fallow period	**n=240**	
No	77	32.1
Yes	163	67.9
Total	240	100
If yes, when?	**n=163**	
After 1st crop	62	38
After 2nd crop	127	77.9
After 3rd crop	65	39.9
Length of fallow periods	**n=163**	
1 to 2 weeks	74	45.4
2 to 3 weeks	65	39.9
1 month	127	77.9
More than 1 month	104	63.8

More than half of the respondents achieve a grain yield of 4,000 to 7,000 kg/ha during the third crop. The average yield of the third crop is also higher than the first and second crops. One-fourth of the respondents achieve a yield of 5,000 kg/ha and above during the third crop. Farmer respondents obtained slightly lower mean grain yield in the second crop compared to the first crop.

Seeds and Varieties

In Table 2, the majority of the farmer respondents use high-quality seeds, either certified or registered seeds (83.3%), with the source of seeds being from the government (82.1%). The top three varieties used by the farmer respondents across cropping seasons are NSIC Rc 216 (40.4 to 56.3%), NSIC Rc 222 (18.3 to 32.1%), and NSIC Rc 226 (9.2 to 12.1%), respectively. The main reasons for choosing the varieties include yield (67.9%), eating quality (60.4%), and availability (57.5%), among others. These three varieties had an average yield of 5.4 to 5.7 tons per hectare (t/ha), with a maximum yield ranging from 7.9 to 9.3 t/ha. For eating quality, NSIC Rc 216 and NSIC Rc 226 are more preferred by farmers. Although these three varieties are classified as having intermediate amylose content, NSIC Rc 216 and NSIC Rc 226 have relatively lower amylose content (20.3% to 20.5%) compared to NSIC Rc 222, which has 24.0%.

Crop Management Practices

About half of the farmer respondents (50.4%) implement strategies to hasten decomposition of rice straw (Table 3). Some of these strategies include burning of rice straw (41.6%) and applying lime (8.8%). For the crop establishment activities, the

Table 2. Varieties and seed class/type used by farmer respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Seed class/type	**n=240**	
Certified/ registered seeds	200	83.3
Good seeds	60	25
Hybrid	19	7.9
Source of seeds	**n=240**	
Government	197	82.1
Own seed stock	29	12.1
Exchanged from other farmers	8	3.3
Seed growers/ bought from agricultural stores	8	3.3
Rank Varieties used	**n=240**	
1st cropping		
1 NSIC Rc 216	111	46.3
2 NSIC Rc 222	77	32.1
3 NSIC Rc 226	22	9.2
2nd cropping		
1 NSIC Rc 216	97	40.4
2 NSIC Rc 222	50	20.8
3 NSIC Rc 226	29	12.1
3rd cropping		
1 NSIC Rc 216	104	43.3
2 NSIC Rc 222	44	18.3
3 NSIC Rc 226	28	11.7
Reasons for choosing the varieties	**n=240**	
Yield	163	67.9
Eating quality	145	60.4
Availability	138	57.5
Consumer preference	93	38.8
Higher prices or market	80	33.3
Pest resistance	53	22.1

Table 3. Variables related to crop management practices of the respondents (Year 2021)

Variable	Frequency	Percentage (%)
Strategy to hasten the decomposition of rice straw		
None	119	49.6
Application of lime	21	8.8
Burning of rice straw	100	41.6
Total	240	100
The crop establishment method used	**n=240**	
Direct seeding	184	76.7
Transplanting	31	12.9
Both	25	10.4
Total	240	100
Direct seeding	**n=209**	
Type of direct seeding		
Dry direct	24	11.5
Wet direct	185	88.5
Transplanting	**n=56**	
Type of seedbed used		
Wet seedbed	16	28.6
Dapog	40	71.4

Table 4. Variables related to types of fertilizers used by the respondents. (Year 2021)

Types of Fertilizers Used	1st Application		2nd Application		3rd Application	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Complete	**n=240**		**n=240**		**n=240**	
14-14-14	**159**	**66.3**	**150**	**62.5**	**52**	21.7
16-16-16	21	8.8	16	6.7	8	3.3
Single element	**n=240**		**n=240**		**n=240**	
46-0-0	182	75.8	138	57.5	50	20.8
21-0-0	5	2.1	15	6.3	33	13.8
0-17-0	3	1.3	2	0.8	0	0
0-0-60	9	3.8	22	9.2	42	17.5
Double element	**n=240**		**n=240**		**n=240**	
16-20-0	77	32.1	72	30	32	13.3
18-46-0	8	3.3	8	3.3	0	0
17-0-17	0	0	6	2.5	9	3.8

Table 5. Pest problems encountered by the respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Insect pest problems	**n=240**	
Stemborer	218	90.8
Rice bug	176	73.3
Brown planthopper/Green Leafhopper/White-back planthopper	106	44.2
Rice black bug	95	39.6
Leaf folder	5	2.1
Other defoliators	1	0.4
Disease problems	**n=240**	
Rice blast	127	52.9
Bacterial leaf blight	125	52.1
Rice Tungro disease	65	27.1
Brown spot	29	12.1
Weed problems	**n=240**	
Grasses	226	94.2
Sedges	200	83.3
Broadleaves	142	59.2
Other pest problems	**n=240**	
Rodents	197	82.1
Snails (GAS)	195	81.3
Birds	164	68.3

Table 6. Variables related to the pest management of the respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Management of insect pest problems	**n=240**	
Insecticide application	230	95.8
Regular insect monitoring	162	67.5
Hand picking	20	8.3
Use of insect traps and attractants	2	0.8
Management of diseases	**n=240**	
Fungicide application	165	68.8
Removal of infected plants	12	5
Water management e.g., in controlling rice blast and bacterial leaf blight	1	0.4
Use of concoction: Oriental Herbal Nutrient (OHN)	1	0.4
Management of weeds	**n=240**	
Herbicide application	230	95.8
Water management	178	74.2
Manual hand weeding	65	27.1
Management of other pest problems	**n=240**	
Chemical application	214	89.2
Water management	108	45
Handpicking of snails	65	27.1
Scaring away birds using sounds	1	0.4
Use of scarecrow for birds	1	0.4
Use of traps or bait	1	0.4

majority implement direct seeding (76.7%) as the method used (Table 8). The majority used wet direct seeding (88.5%), while a few used dry direct seeding (11.5%). The seeding rates for direct seeding mostly range from 140 to 160 kg/ha (31.1%), and all are broadcast manually. Most of the farmer respondents who practice transplanting use dapog (71.4%), with a seeding rate of 50 to 80 kg/ha (46.4%), and all were transplanted manually (100.0%).

Fertilizer Management

The average nitrogen, phosphorus, and potassium (NPK) rates (kg/ha) applied by the farmer respondents are presented in Figure 5. NPK rates were highest during the first crop, slightly lower in the second, and lowest in the third. Over half of the respondents apply their fertilizer in three splits (52.9 to 60.8%) irrespective of the cropping season. In terms of timing, the majority applied the first fertilizer application of more than 14 DAS (83.7%), the second application between 24 to 40 DAS (55.5%), and the third application between 38 to 62 DAS (46.9%) for the direct-seeded rice. For transplanted rice, the first application occurred more than 14 DAT (66.1%), the second application more than 31 DAT (58.9%), and the third application more than 40 DAT (26.8%). Most (75.1%) use complete NPK fertilizers with rates of 14-14-14 and 16-16-16 (Table 4). A large portion (75.8%) also use urea (46-0-0) fertilizers during the first fertilizer application, and 32.1% apply ammonium phosphate (16-20-0). A high percentage of the

Table 7. Educational attainment, years of experience, organizational affiliation, membership benefits, and access to rice-related information and technologies of the respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Educational Attainment		
No education/ no schooling	0	0
Elementary	54	22.5
Secondary	127	52.9
Tertiary/ College	59	24.6
Total	240	100
Years in rice farming	**n=240**	
10 and below	31	12.9
11 to 20	81	33.8
21 to 30	55	22.9
31 to 40	49	20.4
41 to 50	19	7.9
51 and above	5	2.1
Total	240	100
Years as IA* members	**n=240**	
10 and below	88	36.7
11 to 20	114	47.5
21 to 30	24	10
31 to 40	13	5.4
41 to 50	1	0.4
51 and above	0	0
Total	240	100
Level of participation in the IA	**n=240**	
Very high	137	57.1
High	32	13.3
Moderate	66	27.5
Low	3	1.3
Very low	2	0.8
Total	240	100
Attendance to seminars or training related to rice farming	**n=240**	
YES	181	75.4
NO	59	24.6
Total	240	100
Focus/ topics of the seminars/ training attended	**n=181**	
Inbred rice production/ PalayCheck	163	90.1
Pest Management	51	28.2
Nutrient management	29	16
Hybrid rice production	7	3.9
Reasons for attending seminars or training	**n=181**	
Learn new technologies	154	85.1
Increase harvest	54	29.8
Avail of freebies	13	5.4
Share learnings with other farmers	129	71.3
Reasons for not attending seminars or training	**n=59**	
No time or not available	42	71.2
No idea about the training conducted	15	25.4
Attend to other important business	10	16.9
Visits by LGU technicians in the Barangay	**n=240**	
YES	211	87.9
NO	29	12.1
Total	240	100
Frequency of visits	**n=211**	
Always	157	74.4
Sometimes	54	25.6
Rare	0	0

*Irrigators' Association

Table 8. Monthly family income, sources of income, and variables related to rice sufficiency in the households of the respondents. (Year 2021)

Variable	Frequency	Percentage (%)
Monthly family income	**n=240**	
< ₱9,520 ($187)	170	70.8
₱9,521 to ₱19,040 ($187 to $373)	54	22.5
₱19,041 to 38,080 ($373 to $747)	9	3.8
₱38,081 to 66,640 ($747 to $1,307)	7	2.9
Total	240	100
Major sources of income	**n=240**	
Rice farming	239	99.6
Salary Employment/Pension	69	28.8
Poultry/livestock production	52	21.7
Vegetable farming	27	11.3
Self-employed/business	27	11.3
Others (sugarcane production)	2	0.8
The volume of rice harvest left for home consumption	**n=240**	
0 to 25%	223	92.9
26 to 50%	15	6.3
51 to 75%	1	0.4
75 to 100%	1	0.4
Total	240	100
The final product of rice sold	**n=240**	
Fresh palay	226	94.2
Milled rice	13	5.4
Seeds	1	0.4
Total	240	100
Price of rice products	**Min-Max**	**Average**
Fresh palay (n=226)		
1st cropping	₱ 10.00 to 19.00	₱15.00
2nd cropping	₱ 11.00 to 20.00	₱17.00
3rd cropping	₱ 12.00 to 22.00	₱19.00
Milled rice (n=13)	₱ 32.00 to 50.00	₱39.00
Ave. Gross Income (₱) per Cropping	**n=240**	
Below ₱10,000.00 (<$196)	18	7.5
₱10,000.00 to ₱30,000.00 ($196 to $588)	106	44.2
₱30,000.00 to ₱50,000.00 ($588 to $981)	54	22.5
₱50,000.00 to ₱100,000.00 ($981 to $1,961)	38	15.8
Above ₱100,000.00 (>$1,961)	24	10
Buyer of rice products	**n=240**	
Traders/ millers	228	95
Private individuals	10	4.2
Cooperatives/ associations	1	0.4
Public market	1	0.4

respondents also used complete fertilizers during the second application (69.2%), while a few still used complete fertilizers during the third application (25.0%).

Pest management

Insect pest problems reported by the respondents include stemborer (90.8%), rice bugs (73.3%), hoppers (44.2%), and rice black bugs (39.6%), among others (Table 5). For the disease problems, the two main problems are rice blast (52.9%) and bacterial leaf blight (52.1%). Weed problems include different types of weeds, with grasses (94.2%) and sedges (83.3%) being the most common. Other pest problems include rodents (82.1%), snails (81.3%), and birds (68.3%). In Table 6, the majority of the respondents use agrochemicals to control these pests, with insecticides for insect pests (95.8%), fungicides for diseases (68.8%), herbicides for weeds (95.8%), and chemical applications for snails (89.2%).

Factors Influencing Technology Adoption
In Table 7, more than half of respondents have attained secondary or high school education (52.9%), almost one-fourth have achieved tertiary or college education (24.6%), and the rest have only reached primary or elementary education (22.5%). One-third of the respondents (33.8%) have 11 to 20 years of experience in rice farming. More than one-fifth have 21 to 30 years (22.9%) and 31 to 40 years (20.4%) of experience in rice farming. Almost half of the respondents have been members of the Irrigators' Association (IA) for 11 to 20 years. More than one-third have been IA members for 10 years or less, and the remaining respondents have been IA members for more than 20 years. Respondents self-assessed their level of participation in IA activities. They rated themselves based on the frequency of their participation in association meetings, participation in training programs, and involvement in maintenance activities, such as mass work for clearing of irrigation canal. More than half of the respondents (57.1%) had a very high level of participation in the association, while some had a moderate (27.5%) to high (13.3%) level of participation. A very small percentage had very low (0.8%) to low (1.3%) levels of participation. More than three-quarters (75.4%) attended training sessions, with the majority participating in seminars or training on inbred rice production or PalayCheck (90.1%). The majority attended the seminars or training to learn new technologies (85.1%) and share learnings with other farmers (71.3%). Among those who did not attend the seminars or training, 71.2% cited a lack of time or unavailability during the sessions as the reason. According to the majority of the respondents, they were regularly visited by LGU technicians in their Barangay.

Socio-Economic Profile
In terms of the respondents' monthly family income (Table 2), the majority earn below ₱9,520.00 (70.8%), while some have a monthly income ranging from ₱9,521.00 to ₱19,040.00 (22.5%), and a few earn between ₱19,041.00 to ₱66,640.00 (6.7%). Rice farming serves as the primary source of income for nearly all respondents (99.6%). More than one-fourth of the farmer respondents have a family member with a regular salary or pension. Some respondents have additional sources of income, such as poultry or livestock production (21.7%), vegetable farming (11.3%), and business (11.3%). A very small number of respondents are sugarcane planters (0.8%). According to the respondents, the majority of them (92.9%) retain 0 to 25% of the rice they produce for home consumption. Most respondents sold fresh palay as their final product (94.2%). Only a very few respondents sell milled rice (5.4%) or seeds (0.4%). The price of fresh palay is higher during the third cropping, followed by the second cropping and then the first cropping, with a two-peso difference per kilo in price between the cropping season. The gross income of the majority ranges from ₱10,000.00 to ₱30,000.00 per cropping, with traders or millers as the buyers of the fresh palay.

DISCUSSION

Throughout Negros Occidental, several rice farmers practice triple-crop rice farming. Secondary data obtained from DA-RFO VI [unpublished data] also show three rice crops per year, even in rainfed areas. However, the majority of farmers are implementing five-crop rice cultivation over two years, which is feasible due to the availability of irrigation systems in BRIS. Only a few farmers in BRIS still plant three rice crops every year accounting for 4.6% because of the alternate schedule by NIA to have two and three rice crops in BRIS for the north and south. The NIA promoted the adoption of the five cropping seasons in two years in support of the FSSP (nia.gov.ph).

The majority of farmer respondents followed the rice-rice-rice cropping pattern with peak season planting season being May to June for the first crop, September to October for the second crop, and January to February for the third crop. The condition is two cropping seasons during the dry season (first and third cropping) and one cropping season during the wet season (second cropping). Third cropping yield is higher than compared to both seasons. During this period, water and sunlight in the area are abundant compared to rice crops planted during the first crop wherein water becomes limited, and the second crop wherein sunlight is limited. The fallow period is regularly emphasized because of its benefits to rice production such as in breaking the pest cycle and allowing full decomposition of rice straws. Rice straws that do not fully decompose may create soil conditions that are not conducive to the optimal growth and development of a rice crop, which can negatively affect the grain yield (Liu et al. 2023). Only some BRIS farmers implemented fallow periods, and several of them did so for less than a month. Some farmers interviewed mentioned strategies to hasten rice straw decomposition during land preparation, especially when they practice three-crop rice cultivation in a year. These farming practices can be validated for future studies and if proven effective, it can be recommended to other farmers to improve their practices on the QTA system.

According to Pintor et al. (2023), the annual yield of Western Visayas (Region VI), where the province is located, is 3.25 tons/ha across seasons. The high rice production of the region was the result of the increased total harvested area rather than the achieved average yield. The increase in cropping intensity has boosted the rice harvested capacity of the physical area, including Bago City and the rice districts in Negros Occidental. The three rice varieties commonly used in the area are NSIC Rc 216, NSIC Rc 222, and NSIC Rc 226. The three main reasons for choosing the varieties include yield, eating quality, and availability. The maximum `yields of these varieties are 7.7 tons/ha for NSIC Rc 216, 8.5 tons/ha for NSIC Rc 226, and 9.3 tons/ha for NSIC Rc 222, and an average yield of 5.4 to 5.7 t/ha (PhilRice 2024). With average yields of 5.4 to 5.7 tons/ha, farmers can still produce around 16 tons/ha annually under a triple-cropping system. The triple cropping system may be one of the most effective methods for increasing land productivity. In terms of availability, these varieties are distributed for free to rice farmers by the Department of Agriculture through the Rice Competitiveness Enhancement Fund (DA Press Office 2020; Mondejar et al. 2024). For eating quality, NSIC Rc 216 and NSIC Rc 226 are more preferred by farmers. Although these three varieties are classified as having intermediate amylose content, NSIC Rc 216 and NSIC Rc 226 have relatively lower amylose content (20.3% to 20.5%) compared to NSIC Rc 222, which has 24.0%.

The crop establishment method for the majority of farmers in BRIS is direct seeding, using wet direct seeding, with a few who practice dry direct seeding. The days to maturity for NSIC Rc 216 and NSIC Rc 226 are 104 days after sowing (DAS), and 106 DAS for NSIC Rc 222 under the direct-seeding method (PhilRice 2024). With these days to maturity, the three varieties can be classified as early-maturing varieties. The duration of maturity is also shortened with direct seeding as the method of crop establishment. The average grain yield achieved by rice farmers in BRIS is only approximately 4,000 kg/ha, with no significant differences between cropping seasons. Some farmers achieve a rice yield of at least 5.0 tons/ha, especially during the third crop. It can be observed that although farmers are using inorganic fertilizers to supplement the rice crop's fertilization requirements, nutrient management problems are related to the type, amount, and timing of fertilizer application. Some farmers in BRIS apply complete fertilizers during the second and third application, more than 31 DAT, in contradiction to the recommended type and timing of applications recommended by PhilRice experts (PhilRice 2020). Fertilizers with three elements, known as complete fertilizers, were applied even during the second and third splits. Some of the farmers applied the nutrients beyond the stage at which the rice crop needed them. For the amount, the average N applied is less than 100kg/ha during the first crop and less than 50 kg/ha for the second and third crop. N is often applied at up to 120 kg/ha to achieve a grain yield of 7 tons/ha or more during the dry season, and 105 kg/ha to achieve a grain yield of 5 tons/ha during the wet season. This may explain the low yield achieved by farmers. Nutrient inputs, such as fertilizers, fill the gap between the crop's needs and the nutrients already present in the soil. These factors may explain the low grain yield achieved by farmers in the BRIS.

Another factor contributing to the continuing practice of the three-crop rice monocropping system in the area is the farmers' access to technology and its availability. The majority of farmers in the area have completed at least elementary or primary education, attended seminars or training related to rice farming, and are regularly visited by the LGU technicians. These factors may influence the willingness of farmers in BRIS to invest in inputs such as seeds, fertilizers, and pesticides for their rice production. Opportunities to increase yields and safeguard rice self-sufficiency can be realized with this type of intensive farming system. Several crop management technologies are now available and being promoted to farmers, which can be readily adopted and improve rice production in BRIS. These include technologies for direct-seeding rice, nutrient management, and pest management, all of which are even packaged into a guidebook for farmers (PhilRice 2020). Interventions could include knowledge sharing and learning about improved nutrient and crop management. However, the majority of them mentioned that the topics they attended during the seminars and training sessions focused on inbred rice production or PalayCheck, which covers integrated crop management (ICM). The ICM concepts covered in the training, however, are not being implemented.

Improving the rice productivity of the farmers will, in turn, improve their income. The study of Albert et al. (2018) clustered families based on income classes: (1) less than ₱9,520 - poor; (2) between ₱9,520 and ₱19,040 - low-income; (3) between ₱19,040 and ₱38,080 - low-middle-income; (4) between ₱38,080 and ₱66,640 - middle-income; (5) between ₱66,640 and 114,240 - upper-middle-income; (6) between ₱114,240 and ₱190,400 - upper-income but not rich; and (7) at least ₱190,400 - rich. The majority of the rice respondents in this study were still considered poor, with a monthly income of less than ₱9,520. The primary source of income for most of them is rice farming. With rice farming, their gross income ranges from ₱10,000 to ₱30,000 per cropping and only ₱30,000 to ₱90,000 per year if they practice triple cropping. This explains why many BRIS rice farmers fall under lower income brackets, particularly those reliant solely on rice production. Increasing their rice productivity, not only per cropping season but also considering the total land productivity for the whole year, will increase their profitability and improve the economic position of farmers in the area.

Environmental problems, such as the trade-offs of the triple cropping system in rice, should also be considered. Tran et al. (2023) investigate the trade-offs between intensive rice production and environmental protection from a sustainable livelihood perspective. According to their findings, the environmental degradation due to overuse of agrochemicals such as fertilizers and pesticides, results in lower marginal benefits for triple-rice production compared to the double-rice production pattern. Oda and Nguyen (2019) analyzed methane emission patterns based on monitoring data from typical triple rice cropping paddies in the Mekong Delta, collected over five years. They found out that total emissions in a crop season doubled in the second crop, tripled in the third crop, and reset after the annual natural flood of the Mekong River. The resetting of emission levels after the annual flood means that rice straw is decomposed without methanogenesis in water because the water contains dissolved oxygen. Tran et al. (2023) also quantified the health risk exposure associated with intensive rice production and found a decline in the health conditions of farming households in the Mekong Delta.

CONCLUSION

This study successfully assessed the extent of triple-rice cropping in Negros Occidental, particularly within the BRIS, identifying Bago City and Valladolid as the primary areas for third-crop rice production. The results validate the widespread practice of triple cropping in the region, where reliable irrigation systems support the planting of rice in three distinct cropping seasons annually. Despite the average yield of 4,000 kg/ha across the cropping seasons, there is potential for increased productivity through improved nutrient management. Issues related to the timing, type, and quantity of fertilizers used by farmers have been identified, presenting an opportunity for enhancing yields through more precise fertilization techniques.

The study confirms the use of early-maturing rice varieties (e.g., NSIC Rc 216, NSIC Rc 222, and NSIC Rc 226) and direct-seeding methods are instrumental in shortening the cropping cycle, enabling the practice of triple cropping. Farmers in the area rely heavily on both inorganic fertilizers and chemical pesticides for pest control. An overlapping planting schedule between cropping seasons is observed in some of the areas of BRIS, which may explain the high reliance on chemical application in controlling pests. This could result in high pest pressure, which may contribute to greater reliance on pesticides. On the other hand, this may present an opportunity to further increase their grain yield, as they are already using inorganic fertilizers and pesticides and are not hesitant to invest in necessary inputs.

ACKNOWLEDGEMENT

The authors would like to thank the Philippine Rice Research Institute (PhilRice) for funding the study and the Philippine Rice Information System (PRISM) unit of PhilRice for providing the data and guidance to successfully generate the spatial data for this study. They would also like to thank the Agriculture Offices of Bago City and Valladolid for their assistance during the survey.

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