

KEY FACTORS INFLUENCING PRODUCTIVITY AND QUALITY OF LOCAL RICE SEED PRODUCTION OF SMALL-SCALE FARMERS IN RATTAPHUM DISTRICT, SONGKHLA PROVINCE, THAILAND

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Abstract: Southern Thailand offers favourable agroclimatic conditions for rice production. However, the poor rice seed production by most small farmers in the area negatively impacts the quality and productivity of rice production. In Rattaphum District, there was a lack of information that identified factors related to the quality and productivity of rice seed production. This study investigated key factors influencing the productivity and quality of rice seeds produced by local farmers in Rattaphum District, Songkhla Province, southern Thailand. The findings revealed that farming practices such as land selection, seed preparation, land preparation, planting method, water management, soil and fertiliser management, weed management, usage of agrochemicals, and harvesting management were affecting the productivity and quality of local rice seed production. The majority (77.2%) of rice seed production was of inferior quality due to contamination of red seeds and other rice varieties. The correlation analysis indicated that the farming practices and the productivity and quality of the rice seeds were positively correlated. These findings suggest the significance of some measures to reduce the amount of red seeds and other rice varieties. Farmers should modify their field processes such as seed preparation, planting methods, and weed management.

Keywords: Farming practices, rice seed production, rice seed productivity, rice seed quality, rice seed production sustainable.

Introduction

Rice (*Oryza sativa*) is a staple crop primarily grown in Southeast Asian countries, producing about 20% of the world's production. Its cultivation plays an economically crucial role in the countries by supporting regional consumption and global demand. Thailand is one of the major rice-growing countries, the sixth largest producer in the world, with a production of 33.5 million tonnes and a planting area of 11.24 million hectares. However, compared to other rice-producing countries in the region, its productivity is significantly low, yielding only about 3,000 kg per hectare [Office of Agriculture Economics (OAE), 2022].

In Thailand, rice is grown mainly in the northeast, northern and central regions, accounting for over 95% of the total production. Although the country's southern peninsula has favourable agroclimatic conditions for rice

cultivation, it occupies only 1.17% of its rice planting area, producing 1.25% of the total production (OAE, 2022). Songkhla Province is one of the top three rice producers in southern Thailand. The largest local rice-producing area in Songkhla Province is Rattaphum District, which produces a local rice variety named Leb Nok Pattani, which is supplied to various parts of Songkhla Province. In 2020, the Rattaphum area produced this variety on a total of 327.12 hectares. Despite planting recommended local rice varieties in the area, the productivity is below the national average, reflecting inefficient and undeveloped rice production (Department of Agricultural Extension, 2020).

In Rattaphum District, Songkhla Province, local rice varieties have been planted by a large number of small-scale farmers. They are suitable for this area's natural and biological contexts,

particularly disease resistance, special tastes, and nutritional values. These are the advantages of producing these rice varieties in this area. However, the yields and quality of the rice seeds produced by the small-scale farmers were lower than the standards. The rice seed production of small-scale farming in this study area is mostly traditional, using seeds from previous harvests. This means that poor-quality seed has a negative impact on both quality and productivity, leading to lower farmer income.

This is a limitation on the farmers' seeds in this area. As poor rice seed quality is one of the main causes of low productivity, improvement in quality rice seed production is the foundation for ensuring sustainable rice production. Note that many studies have approved that using good-quality rice seeds increases rice productivity by 5–25% (Asad-ud-Doullah *et al.*, 2002; Chauhan *et al.*, 2015). Seed quality is generally determined based on disease freeness and purity. Disease-infected seeds affect germination rates and favour the disease spread coupled with pest attacks, leading to significant yield loss and high production costs. The quality seeds are free from impurities like plant parts, inert matter, weed seeds, other varieties, species seeds, etc.

To ensure the production of quality seeds, it is also essential to apply good agricultural practices at all stages of the cultivation process, such as land selection, irrigation, fertiliser application, pest and disease management, harvest, storage, and post-harvesting (Afzal *et al.*, 2016). Thus, agricultural practices recommended by the rice institute or relevant authority on the farm management system of rice seed production and farmers' adaptability to the recommendations play crucial roles in improving the quality and productivity of rice seed production (Alam *et al.*, 2013). Haque (2007) reported that most farmers who followed the recommendations could produce healthy and good-quality seeds with a greater germination rate; thus, their rice seed yields were significantly high. Hence, the farmers' practices in their rice seed fields are important factors that affect the productivity and quality

of rice seeds. Appropriate practices in rice seed fields can suggest guidelines to improve the yield and quality of rice seeds in Rattaphum District by reducing poor productivity and improving the seeds' quality by modifying the farmers' management in their fields. It would be good for the rice seed community centre to make short-term and long-term plans to study the farmers' circumstances and then formulate good management practices in the rice seed fields to reduce the poor seed. Even though few farmers meet the standards, they can gradually raise the quantity and quality of their seeds and eventually meet the standards. This is a good opportunity for Rattaphum District to be an outstanding and sustainable local rice seed producer and to enhance food security in this area and other parts of Songkhla Province.

This study focused on local rice seed cultivation in southern Thailand. It aimed to investigate the farming practices, quality, and productivity of rice seed production by local rice farmers. Consequently, it analyses the farming practices correlated with the productivity and quality of rice seed production and provides insights on how to increase the quality and productivity of rice seed.

Materials and Methods

The study was conducted in a rice-growing area of small-scale farmers in Rattaphum District, Songkhla Province, in southern Thailand is located at 7°8'6"N, 100°16'24"E, and consists of five sub-districts and 63 villages. As of 2024, it had a population of 75,709 people. The area is mostly plain, and some parts are mountainous. The climate has two seasons: Summer, from mid-February to mid-May and the rainy season. It is from mid-May to mid-February. The average temperature throughout the year is about 27.0°C. The average lowest temperature is 23.2°C. The average highest temperature is 32.5°C. The hottest month is April. The average rainfall throughout the year is approximately 1,726.3 mm and there are approximately 167.9 days of rain. Note that the month with the most rain is November, with an average rainfall of

approximately 317.1 mm. The farmers mainly produce local rice seeds named Leb Nok Pattani, Sang Yod Phattalung, and Cheang Phattalung to supply other rice-growing areas of southern Thailand. The area has a total population of 119 farmers, comprised of 61 farmers from the Ban Nong-on Rice Community Centre (BNRCC) and 58 farmers from the Ban Kanman Rice Community Centre (BKRCC).

Field Surveying of Rice Seed Production

The study focused on the rice production for seed (cultivated in August-March 2022) of 87 farmers (44 farmers from BNRCC and 43 farmers from BKRCC) selected from the total population using a purposive sampling technique. After testing the internal consistency of the farmers with surveys, semi-structured interviews and field surveys were conducted with the farmers to understand their farming practices in rice seed production.

Productivity of Rice Seeds

The productivity data for rice seed production were collected from local rice seed farmers. The study classified the farmers' productivity into three levels based on the typical yield of the area, which was around 3,000 kg per hectare (OAE, 2022) (Table 1).

Determination of Rice Seed Quality Parameters

About one kilogram of rice seeds was sampled from each farmer to determine rice seed quality parameters according to the rice seed quality testing manual (Rice Department, 2021). Moisture content was tested using the grain moisture tester PM-450 (Kett Electric Laboratory, Japan). The seed purity and inert matter weight percentages were measured using

100 g drawn from each sample. Note that red seeds and other varieties of seeds were counted based on 500 g of the sample. The germination rate of the sample seeds was determined following the top paper method (Rao *et al.*, 2006).

Statistical Analysis

We analysed the basic planting and production data using descriptive statistics. The reliability test of the survey samples used Cronbach's alpha coefficient. To quantify how often farmers apply the rice seed farming practices, the application levels of farming practices were measured on Likert scales from 1 to 5 as follows: 1 = never, 2 = rarely, 3 = sometimes, 4 = very often, and 5 = always. The study analysed the correlation between farming practices and productivity and quality of rice seed production using Pearson correlation analysis. A *p*-value of less than 0.05 was considered significant.

Results and Discussion

Local Rice Seed Production and Distribution Channels

The rice seed production systems of local small-scale farmers in Rattaphum District, Songkhla Province could be stated in three stages. The first stage was the source of rice seeds, where farmers obtained the seeds for planting (Table 2). Only 15.71% of the total seeds the farmers acquired were from the rice seed centres certified by the government. Meanwhile, most seeds were from traditional sources, accounting for 84.29% of the total seeds, composed of the farmers' saved seeds (63.15%), and exchanged seeds among the farmers (21.15%). Normally, the farmers in this study harvested the best panicles from their fields to keep the rice seeds for planting

Table 1: Productivity levels of rice seed production by the farmers in Rattaphum District, Songkhla Province

Yield Levels	Productivity Levels
< 2,750 kg/ha	Low productivity
> 2,750 ≤ 3,250 kg/ha	Medium productivity
> 3,250 kg/ha	High productivity

Table 2: Distribution sources and productions of local rice seed varieties

Rice Seed Variety	Rice Seeds from Different Sources (kg)			Cultivated Area (ha)	Production (kg)
	Rice Seed Centre	Farmers' Saved	Exchanged among the Farmers		
LNP	0	3,755	1,350	45.52	125,816
SYP	0	1,473	415	18.24	49,920
CP	0	461	140	5.28	15,284
RD43	205	0	0	1.52	4,308
RD85	1,210	0	0	12.96	38,552
Total	1,415	5,689	1,905	83.52	233,880

Note: LNP = Lab Nok Pattani, SYP = Sang Yod Phattalung, CP = Cheang Phattalung, RD 43 = Rice Department 43, RD 85 = Rice Department 85.

in the next season on their farms or sometimes they exchanged the seeds among themselves, resulting in no formal quality control. This is because rice seeds typically undergo narrow genetic mutation after being repeatedly used for some years (Viana *et al.*, 2019).

The second stage is seed cultivation in the farmers' fields (Table 1). The total cultivated area was 83.52 hectares, of which the majority, 82.66% were local varieties: Leb Nok Pattani (LNP) (54%), Sang Yod Phattalug (SYP) (22%), and Cheang Phattalung (CP) (6%), and the remaining 18% belonged to hybrids namely Rice Department (RD) 43 (2%) and RD 85 (16%). The total yield in 2021 was 233,880 kg and the average yield was 2,800 kg per hectare: RD 85 (2,900 kg/ha), RD 43 (2,800 kg/ha), LNP (2,700 kg/ha), SYP (2,700 kg/ha), and CP (2,900 kg/ha). Although the yield of LNP was the lowest, most farmers planted that variety because they believed it was appropriate for the agroclimatic conditions of the area and had high resistance to prevalent diseases and pests.

The last stage was the seed distribution channel (Table 3). The farmers distributed those seeds through four channels: Sale (72.30%), household consumption (20.67%), saved seeds for the next season (5.28%), and seed exchange (1.74%). However, all RD 85 rice seeds produced by the farmers were directly sold to

the rice seed centre. Note that 69.64% of RD 43 was sold to local mills and the remaining 33% was saved for household consumption. The study discovered that no local varieties were sold to the rice seed centre because most did not meet the quality standards. The survey findings indicate that farmers identified their primary weaknesses as the prevalence of red seeds and other varieties surpassing specified criteria levels in their rice seed stocks. About 77.2% of the total rice seeds produced in the study area were sold to traditional channels, notably local mills, middlemen, and retail markets. These findings were in line with the findings of Niangado (2010), which indicated that most rice seeds produced by local farmers in many developing countries are typically distributed through informal or traditional channels rather than official rice seed centres.

Conversely, this study observed that out of the total hybrid rice seed production of 41,552 kg by farmers, all RD 85 seeds, comprising 72.2% of the total hybrids were sold to the rice seed centre. Notably, farmers who registered at the centre were the sole recipients of hybrid seeds provided by the rice seed centre. Consequently, these farmers received comprehensive support from the rice seed centre, which included technical training, access to new hybrids, machinery, and other essential inputs facilitated through the farmers' community centre.

Table 3: Distribution channels of local rice seed varieties

Rice Seed Variety	Household Consumption (kg)	Saved Seeds for the Next Season (kg)	Exchanged Seeds among the Farmers (kg)	Seeds for Sales (kg)	Seeds Sold to Local Mills (kg)	Seeds Sold to Middlemen (kg)	Seeds Sold in Retail (kg)	Seeds Sold to Rice Seed Centre (kg)
LNP	28,596	8,630	2,852	85,738	44,641	36,443	4,654	0
SYP	14,878	2,632	1,034	31,376	16,180	11,605	3,591	0
CP	3,560	1,078	200	10,446	6,450	2,017	1,979	0
RD43	1,308	0	0	3,000	3,000	0	0	0
RD85	0	0	0	38,552	0	0	0	38,552
Total	48,342	12,340	4,086	169,112	70,271	50,065	10,224	38,552

Note: LNP = Lab Nok Pattani, SYP = Sang Yod Phattalung, CP = Cheang Phattalung, RD 43 = Rice Department 43, RD 85 = Rice Department 85.

Farming Practices in Rice Seed Cultivation

According to the Likert scale assessment (Table 4), the study revealed that farmers rated their practice of variety selection at a high-frequency level of 4.22, indicating significant emphasis on this practice during every planting season. However, other practices such as land selection, seed preparation, land preparation, planting method, water management, soil and fertiliser management, and harvesting management were conducted at frequency levels ranging between 2.77 and 3.38. This suggests that these practices were consistently conducted with due care. On the contrary, pest and weed management were rated at the lowest frequency levels, around 2.4. This suggests that either insufficient attention was given to these practices or the farmers faced challenges adhering to the prescribed guidelines.

The Quality of Rice Seeds

Table 5 exhibited information about the quality of rice seeds produced by farmers and the percentage of farmers who could produce, meeting the standards for community rice seeds. The result indicates that more than 92% of the farmers met moisture content, seed germination, purity, and inert matter standards. However, for the criteria of red seeds and other rice varieties, only 25.28% and 28.73% of farmers, respectively met the standard ranges. These observations reveal that the significant weaknesses in the rice seed quality in the study area were the contents of red seeds and other rice varieties in the produced rice seeds.

The study revealed that a majority of farmers, precisely 52.87%, achieved low productivity levels of less than 2,750 kg/ha. Additionally, 35.63% of farmers attained medium productivity, whereas only 11.5% achieved a higher productivity level exceeding 3,250 kg/ha (Table 6). This may be attributed to low-quality seeds.

Table 4: Application frequency of farming practices in rice seed production

Farming Practices	Likert Scale Rate	Application Frequency Levels
Land selection	3.30	Sometimes
Variety selection	4.22	Very often
Seed preparation	3.38	Sometimes
Land preparation	3.27	Sometimes
Planting method selection	2.86	Sometimes
Water management	3.26	Sometimes
Soil and fertiliser management	3.07	Sometimes
Usage of agrochemicals	2.42	Rarely
Weed management	2.41	Rarely
Harvesting management	2.77	Sometimes

Table 5: Quality of rice seed produced by the farmers

Rice Seed Quality Parameters	Mean	Standards*	Percentage of Farmers Produced According to the Standards (%)
Moisture content (%)	13.14	≤ 15	96.6
Seed germination (%)	94.37	≥ 85	98.9
Purity (%)	97.80	≥ 95	92
Inert matter	2.89	≤ 5	92
Red seeds (Number of seeds)	44.75	≤ 10 in 500 g	25.28
Other rice varieties (Number of seeds)	45.01	≤ 20 in 500 g	28.73

Note: * = Rice seed quality standards by the rice seed centre.

Table 6: Yield levels of the rice seed production by the farmers

Productivity Levels	Percentage of the Farmers (%)
Low productivity	52.87
Medium productivity	35.63
High productivity	11.5
Total	100

Correlations of Farming Practices to Rice Seed Productivity and Quality

Table 7 displays the correlations of the local farmers' practices to the productivity and quality of rice seeds in the study area. The results indicate strong correlations between the farmers' productivity and their specific practices, notably land selection, land preparation, water management, soil and fertiliser management, and usage of agrochemicals.

The selection of land with good water-holding capabilities is significantly linked to higher rice seed productivity, suggesting that farmers who prioritise such land tend to achieve better yields than those who do not. In the study area, the soil belongs to the Visai series, characterised by a sandy topsoil with high permeability, making it somewhat unsuitable for rice cultivation (Land Development Department, 2003). Consequently, the soil's capacity to retain water emerges as a primary limiting factor for rice yields in this region. This observation aligns with the findings of Dou *et al.* (2016), who noted a positive relationship between soil water saturation and rice growth. Similarly, Paiman and Effendy (2020) observed that rice plants grown in soil with high water retention capacity displayed greater panicle length and higher yields.

Water availability during land preparation, especially while puddling, positively correlates with rice seed productivity. It is crucial to have enough water to flood the field before ploughing, ensuring more effective puddling. The International Rice Research Institute (IRRI) (2022) recommends the practice of flooding and keeping the water level in the field 2 to 3 cm above the ground a week before ploughing. Therefore, it is essential to have both sufficient rainfall and efficient irrigation systems to ensure high yield and economic success of rice seed production. It was observed that the clay soil in the study area drained water slowly, which caused the field to take longer to dry out. During the harvest season in the study area, it is crucial to have timely water drainage to ensure dry conditions

in the field. The correlation result confirmed that draining water from the field before harvesting positively impacts the yield. When the field is full of water or muddy, harvesting equipment cannot function properly (Hossain *et al.*, 2015). Moreover, if unexpected rain occurs before harvesting, the field can become humid and cause a problem with undesirable pre-sprouting, leading to lower yield. Uraivan *et al.* (2020) also recommended draining water from the field before harvesting as a part of good agricultural practices and harvesting in dry conditions, leading to increased yields.

The study found that soil and fertiliser management positively affected rice seed productivity by improving soil fertility. In the study area, most rice seed fields are cultivated in the same fields for many years, leading to soil degradation. Thus, to improve rice seed productivity and soil fertility in the long term, the rice seed center has recommended combining chemical and organic fertilisers. Using organic fertilisers can enhance soil properties and increase the efficiency of inorganic fertilisers by retaining the input nutrients for a longer availability for plant intake (Bueno & Ladha, 2009).

Using agrochemicals correctly positively impacted rice seed productivity, indicating that the farmers who followed the recommended guidelines for applying and handling agrochemicals from the rice seed centre had higher yields. It was noticed that some farmers just only accomplished farm work in a simple and low-cost way but lacked the knowledge and skills to follow the recommendations. Thus, sometimes, they practised spraying chemicals even when it is windy and humid without considering the chemicals' potential consequences and side effects. Alternatively, Jamil *et al.* (2010) indicated that judicious use of agrochemicals, especially pesticide application in rice production is highly rewarding in increasing rice productivity.

Table 7: Correlations of farming practices to the productivity and quality of rice seed production

	Productivity	Quality Parameters						Other Rice Variety
		Moisture Content	Seed Germination	Purity	Inert Matter	Red Seeds		
Land selection								
• water-holding capacity of the soil	0.364**	-0.044	0.139	0.063	-0.04	0.174	0.158	
Seed preparation								
• reliability of rice seed source	0.173	0.098	0.089	0.276**	-0.266*	-0.197	-0.228*	
• cleanliness of rice seed before planting	0.121	0.089	0.401**	0.459**	-0.455**	0.029	-0.127	
• success rate of germination test before planting	0.088	-0.133	0.307**	0.127	-0.129	-0.068	-0.098	
Land preparation								
• water availability while puddling	0.270**	0.046	-0.099	0.026	-0.035	0.01	-0.039	
Planting method								
• transplanting method	0.021	0.091	-0.031	0.164	-0.171	-0.149	-0.257*	
• appropriateness of planting spacing	0.065	0.006	0.091	0.285**	0.274**	-0.357**	-0.519**	
Water management								
• draining out the water from the field before harvesting	0.320**	-0.123	0.138	-0.118	0.119	-0.017	-0.018	
Soil and fertiliser management								
• application of both chemical and organic fertilisers	.352**	-0.063	-0.012	0.046	-0.053	0.022	0.025	

Usage of agrochemicals							
• correctness of pesticides and agrochemical applications	0.763*	0.566	-0.196	-0.555	0.648	-0.075	0.136
Weed management							
• regular check and removal of abnormal rice seedlings in the field	-0.063	0.036	0.039	0.187	-0.167	-0.201	-0.274*
Harvesting management							
• cleanliness of the harvester	0.079	0.074	-0.916	0.317**	-0.328**	-0.067	0.663
• reducing moisture content after harvest	0.066	-.577**	0.137	0.034	0.035	-0.019	0.017

Note: ** = correlation is significant at the *p*-value of 0.01. * = correlation is significant at the *p*-value of 0.05.

The study discovered that certain farming practices such as seed preparation, planting methods, weed management, and harvesting methods significantly impacted the quality of rice seeds. During seed preparation, the reliability of the rice seed sources positively correlated to the seed purity. However, it was inversely associated with the amount of inert matter and other varieties. The study established that the farmers who received the certified seeds from the rice seed centre could produce quality rice seeds with high purity. Mandal *et al.* (2020) reported that most rice seeds saved by farmers were uncertified and kept improperly, leading to poor purity and germination rates. Seed cleanliness had a positive correlation with seed germination and seed purity. Nonetheless, it had a negative correlation with inert matter. Normally, in this area, traditional farmers clean seeds by hand, using sieves to separate different sizes of seeds and to remove stones, soil, and plant matter. Removing abnormal and diseased seeds before planting would result in high purity, germination, and less inert matter. The germination test before planting was positively correlated with the seed germination. Seeds with high germination and vigour are relatively free of unhealthy seeds (Naher *et al.*, 2016). According to a study by Mathur *et al.* (2004), proper seed preparation resulted in an 87% increase in germination rate and a reduction in brown spot, blast, and seed blight.

Regarding the planting method of rice seeds, transplanting and appropriateness of planting spacing showed a positive correlation with seed purity and a negative correlation with inert matter and contamination with red seeds and other rice varieties. The transplanting method allows for the appropriate planting spacing, ensuring plant uniformity, proper planting density, and weed control (Khan *et al.*, 2017). Moreover, it had low chances of disease and pest infestation. Nevertheless, weed control could not be carried out effectively without the appropriate spacing, leading to high weed proliferation and increased contamination of inert matter, red seeds, and other rice varieties (Chauhan & Johnson, 2011).

It was also examined that the regular check and removal of abnormal rice seedlings as the weed management in the field negatively correlated with the contamination of other rice varieties. Akbar *et al.* (2011) indicated that removing the abnormal seedlings from the field significantly improved the seed quality.

During the harvesting, the cleanliness of the harvesters showed a positive correlation with seed purity and a negative correlation with inert matter. In the study area, it was noticed that many farmers shared a harvester, which led to inadequate cleaning of the machine. Consequently, the seeds had low purity and higher levels of inert matter. Drying the rice seeds immediately after harvesting had a negative correlation with the moisture content of the seeds, indicating better seed quality. High moisture content in rice seeds is undesirable (National Bureau of Agricultural Commodity and Food Standard, 2014) because it favours the premature sprouting of seeds, as well as insects and fungus attacks. According to IRRI (2022), dry, freshly harvested rice seeds are recommended to maintain the appropriate moisture content and prevent deterioration caused by excessive moisture.

Conclusions

This study was motivated by the reports that the yields and quality of the rice seeds produced by the small-scale farmers in the Rattaphum District were lower than the standards, mostly traditional, and farmers use seeds from previous harvests. The study aimed to investigate these claims and analyse local rice farmers' farming practices, quality, and productivity of rice seed production. It further analysed the relationship between farming practices and rice seed productivity and quality. Consequently, the study revealed challenges and practices small farmers are involved in in rice seed production. The primary concern was the prevalence of red seeds and other varieties surpassing specified criteria levels in rice seed stocks.

This indicates potential issues with seed purity and quality control. Most rice seeds were sold through traditional channels such as local mills, middlemen, and retail markets with low prices. Only a small portion of hybrid rice seeds was sold to the rice seed centre. For rice seed production, farmers rated variety selection with high frequency. This indicated that farmers are attentive to choosing suitable rice varieties for cultivation.

Meanwhile, variety selection was highly emphasised, and other practices such as land selection, seed preparation, land preparation, planting method, water management, soil and fertiliser management, and harvesting management were conducted at medium frequency levels. This implied that there may be room for improvement and guidelines for increasing rice seed productivity. Pests and weed management were rated at the lowest frequency levels, suggesting insufficient attention or challenges in implementing effective pest and weed control measures.

The study established correlations between farmers' practices in the fields and rice seed productivity. Practices such as land selection, land preparation, water and soil management, and the usage of agrochemicals were correlated with seed productivity. Again, various farming practices were correlated with different aspects of rice seed quality. For instance, seed preparation correlated with germination, purity, amount of inert matter, and other varieties of seed. Planting methods correlated with purity, moisture, amount of inert matter, and amount of red seed and other seed varieties. Note that weed management correlated with the amount of other seed varieties and harvesting methods correlated with purity, moisture, and amount of inert matter in the seed. These findings highlight the importance of addressing challenges in seed purity and quality control, as well as the need for attention to pest and weed management practices to improve overall rice seed production among small farmers.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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