Journal of Food Technology Research
2023 Vol. 10, No. 3, pp. 62-74
ISSN(e): 2312-3796
ISSN(p): 2312-6426
DOI: 10.18488/jftr.v10i3.3486

The effect of using quality rice seed varieties on rice cultivation activities

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Article History
Received: 10 July 2023
Revised: 4 September 2023
Accepted: 15 September 2023
Published: 26 September 2023

Keywords
Crop management
Farmer
Productivity
Quality varieties
Rice cultivation
Rice seed varieties.

ABSTRACT

Farmers' use of subpar rice seed has a substantial impact on the production of rice harvest since it may result in the spread of disease and pests, the incapacity of crops to adapt to climate change, poor soil quality, and bad plant structure. In this context, the situation mentioned earlier has a detrimental impact on farmers' financial earnings as well as an escalation in expenses related to input procurement and crop management, thereby influencing the overall welfare of farmers. Therefore, this study was carried out to identify the selection of rice seed varieties within five seasons of cultivation among farmers and the effect of using quality rice seed varieties on rice cultivation activities. The study employed the descriptive quantitative research approach, and the survey instruments were administered to a sample of 95 rice farmers residing in the AFO F-IV Sungai Limau MADA area, Yan, Kedah. The results of the study found that most respondents used the MR297 rice seed variety for each planting season due to their confidence in the agronomic characteristics of the variety. The findings also indicate the impact of using quality varieties recommended by agricultural agencies. These include increased production, crop tolerance to weather factors, higher resilience, and resistance to disease attacks. This situation has real impacts, including increased farmers' income, lower costs of purchasing production inputs, and farmers' well-being. This has several consequences for technological advancements in creating high-quality rice seed varieties and their usage by farmers, which can boost rice output, the economy, and the well-being of the farmers, in addition to assuring the security of the nation's rice supplies.

Contribution/Originality: The current work has significant implications for national food security and increases farmers' incomes through the use of high-quality rice seed varieties. The government should prioritize the R&D of high-quality rice seed varieties that can withstand various issues at the farm level and encourage farmers to use quality rice seed varieties to ensure national food safety and the farmer's well-being.

1. INTRODUCTION

Rice serves as a significant staple meal in numerous regions across the globe. Given that Asia is widely recognized as the global hub for rice production, it follows that the rice business holds significant strategic importance for numerous nations in Southeast Asia. It is anticipated that the rapid expansion of the population will

result in a corresponding rise in the demand for rice in the future. In this regard, using quality rice seed varieties that are high-yielding is important. However, Asian countries face low rice productivity due to various challenges, including abiotic and biotic stress conditions. Climate change has created abiotic stress conditions that lead to crop stress due to drought and flooding, extreme temperatures, salinity, mineral deficiency, wounding, and oxidative stress. Meanwhile, biotic stress causes fungal pathogens in the blast, bacterial leaf blight and insect attacks, sheath blight, viruses, and false smut on the crops (Akos et al., 2019; Dar et al., 2021). Issues in rice production are often associated with reduced production due to disease attacks, pests, global climate change, deteriorating soil fertility levels, the use of chemical inputs, increased input costs of fertilizers and poisons, greenhouse gas emissions, and shrinking cultivation areas (Ibrahim & Siwar, 2012; Jena et al., 2023; Rosmiza, Muhammad, Milah, & Mohd, 2021).

China, the world's largest rice-producing and consuming country, has experienced a crisis of declining rice production due to biotic stress such as rice blast disease, brown planthopper, bacterial leaf blight, sheath blight, false smut, and striped rice stem borer caused by low-quality rice varieties (Wang, Xue, & Li, 2005). Similarly, Bhapkar, Kulkarni, and Chavan (1960) found that India's main rice production region is threatened by the Bacterial leaf blight (BLB) disease caused by *Xanthomonas oryzae pv. Oryzae* (*Xoo*)**,** especially during the monsoon season. The disease is linked to the implications of selecting low-quality rice varieties, which reduce rice's resistance to diseases. This situation has caused a significant deterioration in yields, resulting in large losses for farmers. Moreover, in the long run, the use of the same variety in the planting area will cause productivity to decrease due to limited genetic capabilities. Technological innovation, specifically developing and using new high-quality rice varieties and crossbreeding between local and other varieties, is an important instrument in increasing rice production. Technology has allowed the introduction of new varieties with increased capacity than the existing varieties and has the potential for high productivity, higher tolerance to weather changes, resistance to diseases and major pests, stronger plant structure, a higher number of stems (seedlings /meter^2) and can be cultivated in less fertile areas (Bobihoe, 2021; Jena et al., 2023), besides catering to local taste. The use of quality varieties will result in lower sowing and replanting frequencies, stronger rice seedlings with more uniform growth, and a faster growth rate. Stronger rice seedling growth in the early stages of crop development might lessen weed competition issues and boost crop tolerance to diseases and pests (MARDI, 2016). As a result, new varieties will become more stable, and both abiotic and biotic stresses will significantly decrease (Bobihoe, 2021; Jena et al., 2023).

New agricultural technologies have contributed to significant positive changes in crop production and efficiency at the farm level, increased farmers' income, reduced the poverty rate, and improved the well-being of farmers' households (Assaye, Habte, Sakurai, & Alemu, 2022). Farmers' use of quality rice seeds can positively affect rice productivity and food security. Therefore, this study was carried out to identify the rice seed varieties chosen for cultivation by farmers and to analyze the impact of using quality rice seed varieties on rice cultivation activities.

2. LITERATURE REVIEW

2.1. Rice Varieties in Malaysia

Each rice-producing country uses varied government-approved rice varieties produced through breeding based on the local situation. New rice varieties with better genetic traits increase productivity and are consistently introduced annually. The Black Asian, Manchurian Rice, Oryza Rufipogon, Ponlai, and Wuchang rice varieties have become the preferred options for farmers in China. Meanwhile, in Indonesia, hybrid varieties, such as Intani 1 and 2, Bernas Prima, Rokan, Segera Anak, Adirasa 1 and 64, and Hibrindo R-1 and R-2, have become the predominant and most popular rice varieties in addition to the superior varieties. Furthermore, Malaysia's ongoing Research and Development program has produced various varieties from the Japonica and Indica rice groups. These hybrid varieties produce stronger plants with higher resistance to certain diseases, uniform plant growth, collapse resistance, a shorter maturity period, and high yield potential (Zainudin, 2010). In 2009, the Malaysian government established the Paddy Seed Certification Scheme, which requires that all farmers use registered and verified rice

seeds for cultivation. The scheme is a quality certification system for producing and supplying rice seeds according to the conditions and standards set for planting purposes. This scheme is a government-funded crop seed management plan to ensure the proper selection of seeds and achieve the standards set by the Department of Agriculture. Crop seed management programmes include systematic and procedural registration of producers, application and verification of seed farms, inspection of seed farms and plant processing plants, harvesting and processing of raw rice seeds, submitting the seed lot processing seed records, collecting seed samples, rice seed quality testing, reprocessing of rice seeds, stock inspection, seed quality certificate verification, marketing and labelling of register (Jabatan Pertanian Malaysia, 2011). The government also provides several incentives or subsidies for producing certified rice seeds to overcome the shortage of certified rice seeds and to ensure farmers use quality certified rice seeds to improve farmers' standard of living in line with higher rice production (Ibrahim & Siwar, 2012). Malaysian farmers favor the Malaysian rice (MR) varieties MR297, MR219, and MR303. MR297 is advantageous due to its resistance to leaf and stem blight and red stripe disease, as well as being moderately resistant to brown planthopper pests. The variety will mature within 110 to 115 days after being sown directly in the fields. Next, the variety has a height ranging from 64.4 to 70.0 cm and a rice turnover of about 61.4 percent. It also has a low amylose content of 21.4 percent, which contributes to a softer rice texture (MARDI, 2016). The MR219 variety has moderate resistance to red stripe disease and bacterial blight. The production yield is higher, averaging 6500 kg/ha. The MR219 variety also has an average of 88 rice grains per stem, contains low amylose, and has a softer rice texture. The variety gained the attention of farmers across the country, causing its demand to increase from 66.8 percent in 2004 to 85.0 percent in 2010 (Zainudin, Amirrudin, Badrulhadza, Marzukhi, & Bahagia, 2012). However, the lower resistance of the MR219 variety to rice blast disease prompted the development and introduction of several new, highly successful varieties, such as MR253, MR263, and MR269 (MARDI, 2016).

The MR303 variety has the potential to produce high yields and is less sensitive to environmental factors. This rice variety is suitable for cultivation in most areas and is recommended for less fertile areas. It is also highly resistant to leaf blight, moderately resistant to stem blight, and pests like brown planthoppers. MR303 has short, upright flag leaves and a long stem, with an average plant height of 120.3cm and a stem length of 28.3cm. The percentage of rice seed filling per stem is more than 70 percent. MR303 is categorized as a fast-maturing rice variety with a maturity period of 104-106 days, and its yield can reach up to 10 tons/ha, generating a good income for farmers. In addition, this variety offers a rice taste that meets the needs of local consumers (Elixon et al., 2019). The UKMRC-2 (Universiti Kebangsaan Malaysia rice-2) variety, on the other hand, was introduced in 2019. The maturity period is 118 to 122 days, the plant height ranges from 88 to 95cm, the stem length is 21 to 27cm, and the rice turnover is 88.5 percent. It produces low-starch, less sticky, and easily separated cooked rice (Nomatech, 2019). In general, introducing new varieties could complement the weaknesses of existing varieties, among them the crop's resistance to weather factors and the local environment. It can also increase production yields and the level of resistance to diseases and pest attacks.

2.2. Impact of the Use of Quality Rice Seed Varieties on Rice Cultivation Activities

Developing quality rice varieties that can adapt to a particular environment is important for ensuring increased productivity. In Asia, low rice productivity is due to various current challenges and the effects of climate change that cause abiotic stress conditions such as drought and floods, extreme temperatures, salinity, mineral deficiency, wounding, and oxidative stress (Akos et al., 2019; Dar et al., 2021). Meanwhile, biotic stress involves fungal pathogens of the blast, bacterial leaf blight and insects, sheath blight, viruses, and false smut (Akos et al., 2019). This stress condition will affect germination, length and width of leaves, vegetative growth, reproductive stages, and tillering, thus affecting productivity (Dar et al., 2021). This situation risks food safety in developing countries, especially in areas exposed to droughts. Thus, tissue culture for producing drought-resistant varieties can effectively increase crop productivity in water-shortage areas (Che et al., 2016). Climate change phenomena such as

floods and droughts have caused concern among farmers. This is because flooding over a long period of time will cause the paddy fields to sink. This will cause problems regarding costs and the huge losses that farmers must bear. Thus, introducing varieties that tolerate abiotic stress through mutation breeding is one of the most efficient approaches (Ahmad et al., 2022). A study by Mokhtar et al. (2012) focused on the MR276 and MR219 varieties and found that MR276 showed better resistance than MR219 in a two-week flood situation. The average yield of the MR276 variety is 6.63 t/ha compared with 5.79 t/ha for the MR219 variety. The yield range for MR276 was 4.69 t/ha to 8.89 t/ha, compared to 3.34 t/ha to 8.28 t/ha for MR219. In the meantime, MR276 requires a specific fertilizing package for high-yield production due to its different plant habits and morphology from MR219 or previous varieties. The newly introduced aerobic rice by Universiti Kebangsaan Malaysia Rice (UKMRC) (Harun, 2015) and UKMRC-2 and UKMRC-8 rice varieties have the potential to be grown in paddy fields experiencing water shortages and rain catchment areas (Sariam et al., 2014). The aerobic rice varieties are also suitable for cultivation in land areas as a transition crop that can eliminate the living disease cycle of the previous crops. As a side crop, aerobic paddy can be cultivated in rubber or oil palm replanting areas (0-3 years) to optimize land use and increase farmers' income (Sariam et al., 2014). The selection of substandard varieties of rice seeds can increase the paddy crop's vulnerability to pest attacks and diseases. For example, four New Superior Varieties (NSV) were released, namely Cimelati (2001), Gilirang (2002), Ciapus (2003), and Fatmawati (2003). However, these varieties were withdrawn due to their high empty grain content and low resistance to major diseases and pests (Sutardi et al., 2022). Pest attacks could threaten farmers' income and increase crop management costs for purchasing insecticides and fertilizers. It can also reduce yields and production quality, affecting the farmers' living standards (Rosmiza et al., 2021; Sutardi et al., 2022). As such, the Indonesian Center for Rice Research (ICRR) introduced two new varieties, Inbrida Swamp Rice (Inpara) and Inbrida Irrigation Rice (Inpari), which can produce high yields (Hidayanto, Fiana, Amin, Sujalu, & Sumarmiyati, 2021). They are also resistant to weather stress, disease attacks, and pests (Sutardi et al., 2022). Inpara is more tolerant to iron toxicity and can absorb different nutrients. A common disease for rice crops in Indonesia included bacterial panicle blight (BPB) (*Xanthomonas campestris pv. Oryzae*), tungro virus, *Pyricularia grisea*, *Helminthosporium sigmoideun*, *Rhizoctonia solani kuhn*, and Reget stunt, which contributed to the decline of between 15 to 24 percent of yield (Nuryanto, 2018; Semangun, 2008). While in the generative phase of pest management, green leaf hoppers were decreased in these two varieties (Jefri & Johanna, 2023). Therefore, selecting and using quality rice varieties is important to prevent pest attacks and diseases in rice crops (Amzah, Misman, Mohamad, & Vun, 2013). This is because selecting healthy rice seeds can reduce the initial inoculum of disease-causing pathogens, especially pathogens transmitted through rice seeds. This method is an inexpensive, easy, safe, and effective way of handling plant diseases (Nuryanto, 2018).

Good management of rice seed varieties will affect the yield of rice production according to the suitability of the varieties and the method of caring for the rice varieties used in rice cultivation. The performance of the MR253 new rice variety has been evaluated across four planting seasons, specifically the 1/2019, 2/2019, 1/2020, 2/2020, and 1/2021 seasons in five main rice cultivation areas in Malaysia. The average yield is 6.0 tons/ha compared to 5.2 tones/ha for the MR219 variety (Elixon et al., 2012). In this light, the MR253 variety is produced with the aim of producing disease resistance, thus reducing production costs for crop disease management while sustaining the welfare of farmers and preserving the environment. Based on the screening test, MR253 was identified as resistant to sheath blight but moderately resistant to stem blight, brown plant hopper, and bacterial leaf blight, and red stripe disease, but susceptible to sheath blight. The level of resistance to 13 pathotypes of fungi (*Pyricularia oryzae*) that cause many diseases is comparable to the MR232 variety but much better when compared with other rice varieties. In addition, the rice varieties MR253 and MR263 were also introduced to farmers to overcome the problem of acidic paddy fields (Azmi et al., 2012). The selection of quality rice varieties can reduce the attack of rice diseases, besides preventing farmers from incurring losses due to uncertified and low-quality rice seed varieties (Elixon et al., 2012). The selection of unregistered rice seeds without authenticity verification and unregistered by

agricultural agencies often leads to a weedy rice population. This type of paddy is a weed derived from the same genus as the rice cultivar, i.e., *Oryza* (Faridah, 2011). The widespread presence of weedy rice in rice cultivation areas is a major problem for farmers (Rosnani, Tapsir, & Azmi, 2013), especially in Southeast Asia, South Asia, America, and Southern Europe. In this regard, there is no specific herbicide capable of inhibiting the growth of this weed. Weedy rice is said to be more efficient at absorbing fertilizers and nutrients from the soil than rice cultivars, causing it to grow faster than rice plants. The height of the weedy rice is also an advantage. It can easily grow higher than rice cultivars, creating competition for sunlight and eventually causing the death of the rice plant. The growth effect of weedy rice will reduce rice yield by up to 80 percent with a stem density of 21 to 30 stems/m2 (MARDI, 2018). This is one of the reasons for the restriction on using low-quality rice seeds, as it will affect the production of rice and cause losses to the farmers.

Thus, developing new varieties should be a continuous effort based on the needs and current conditions to ensure higher rice production (Harun, 2015). The Research and Development (R&D) program continues to focus on producing high-yield fast-maturing varieties with a yield average of 7 to 8 tons/hectare in a shorter period to overcome the problem of weedy rice, which can reduce yields by up to 74 percent, affecting farmers' income (Azmi et al., 2012). Thus, the Malaysian Agricultural Research and Development Institute MARDI (2018) introduced the Clearfield Production System (CPS) to overcome problems related to weed control with the introduction of Clearfield (CL) rice varieties, namely MR220-CL1 and MR220-CL2. The variety was introduced to overcome the problem of wind paddy infestation, which affects almost 10 percent of the paddy fields in Malaysia, and to provide a high-yield rice variety with a short maturity period of 90 days to increase rice production (Azmi et al., 2012). The introduction of CPS has benefited the rice cultivation industry in Malaysia by offering effective chemical controls to control weedy rice and other competitor weeds through direct sowing (Azmi et al., 2012). The CPS consists of three components: seeds of imidazolinone-tolerant rice varieties, MR220-CL1 or MR220-CL2, On Duty herbicide, and a usage guideline. The system has been commercialized through the direct sowing method and the practice of package technology recommended specifically to control the weedy rice problem. The use of the system can benefit the country's rice industry by effectively controlling weedy rice and other weeds, increasing the production of rice crops, and reducing the cost of purchasing production inputs (Rosnani et al., 2013).

According to Bobihoe (2021), the superior varieties Baroma and Inpari Nutri Zinc were developed and introduced in Jambi Province to compete with the imported and more expensive Basmathi variety. The Baroma variety produces an average of 9.18 tons/hectare, higher than the Basmathi. The stem and plant exhibit a comparatively reduced stature in relation to Basmathi, accompanied by a maturity duration of 113 days. This variety demonstrates higher resistance to diseases and pests, but it requires scrupulous handling during post-harvest handling due to its small and long grain shape, which makes it break easily. Inpari Nutri-Zinc also has a high yield and resilience to Blas and Tungro's diseases. Introducing this variety can promote a healthy diet due to its higher zinc content. In this regard, it could address zinc deficiency and the problem of stunting among the Indonesian population. It also has a better rice taste and increased disease resistance. Its high yield could increase productivity, leading to a higher quality of life for farmers.

The cultivation of quality varieties by farmers can have a positive effect on their level of well-being. Assaye et al. (2022) study in Ethiopia found that, on average, the rice productivity and rice commercialization index (RCI) are increasing, in addition to lowering the poverty index among farmers. Studies by Islam (2018) in Bangladesh have also proven that farmers' well-being is increasing due to increasing yields using quality varieties. The well-being of farmers can be seen through increased production yields, household income, a reduction of the poverty gap, increased employment opportunities, and wage rates, in addition to food security.

The ease of access for farmers to the introduced quality varieties can help increase farmers' yields and profits, thus improving their well-being (International Rice Research Institute (IRRI), 2022). The Asian Development Bank (2018) introduction of a new rice variety, Jasberry, in Thailand has helped small farmers out of poverty. This is due

to higher production yields compared to previous varieties and higher selling prices. Thus, farmers can increase their income. Even the diet of farmers and families is improving because the variety has a higher nutritional and antioxidant value compared to previously grown varieties, in addition to farmers enjoying its health benefits. Higher income from rice sales is leveraged by making additional investments through animal husbandry activities. Farmers began to expand the enterprise into the field of animal husbandry in addition to growing rice. Farmers reuse livestock manure as organic fertilizer to cultivate rice and other crops, thus reducing the cost of purchasing fertilizer input. As a result, the income and well-being of farmers are increasing.

3. METHOD AND STUDY AREA

The Muda Agricultural Development Authority (MADA) and Area Farmers Organization (AFO) F-IV, Sungai Limau, Yan, Kedah, use a quantitative study design to identify the rice seed varieties that farmers cultivated during the five planting seasons, namely seasons 1/2019, 2/2019, 1/2020, 2/2020, and season 1/2021. However, this study only focused on two varieties of rice seeds for all planting seasons. The study also analyzed the effects of using quality rice seed varieties on production. The survey instrument involved a questionnaire distributed to 95 respondents (farmers). Descriptive studies were analyzed to obtain frequency, mean, variety, and standard deviation.

The AFO F-IV was selected as the study area because it has a rice crop area of 97 percent, equivalent to 3489.40 hectares. Another crop occupies the remaining land area (three percent, or 3590.60 hectares) (MADA Sungai Limau, 2021). This has made MADA Sungai Limau, Yan, and Kedah one of the main activity centers for rice farming.

4. RESULTS AND DISCUSSION

4.1. Profile of Rice Cultivation Activities

This study's respondents comprised 95 randomly selected farmers involved in rice crop farming in MADA AFO F-IV. All respondents are male (100%). In this regard, rice farming is male-dominated because rice cultivation activities and crop management require a lot of energy. 56 (58.9%) respondents have a field size of between one and two acres, and only six people (6.3%) have five to six acres of paddy fields. Next, most respondents (55, 57.9%) cultivate rice crops as their main source of income, while 40 (42.1%) take rice farming as a side job. This is due to their keen interest in farming despite having permanent employment in private agencies (25.3%) and government agencies (5.3%), followed by other jobs (11.6%) (Table 1).

Regarding their experience cultivating the rice crop, 33.7% of the respondents have 10 years or more experience (33.7%). This aligns with their age, as most respondents are between 41 and 50. In addition, 20 respondents (21.1%), respectively, have been working as rice farmers for between one and three years and four and six years. Meanwhile, 74 farmers (77.9%) own their fields through individual ownership, while 22.1% rent or lease their paddy fields (Table 1).

A total of 50.5 percent of respondents spent around RM401 to RM600 for rice seed management for one planting season. Only 10 (10.5%) respondents allocated more than RM801 for a planting season. Regarding harvest, 61 respondents (64.2%) obtained a harvest of one to three tons per season due to the small size of their fields (between one and two acres). Meanwhile, 10 people (10.5%) obtained 10 tons or more (Table 1). Most farmers (56.8%) earn less than RM10,000 for a season of rice cultivation, and only a small fraction, eight (8.4%), earn between RM20,001 and RM30,000 and RM30,001 and RM40,000, respectively. This is because their income depends on the size of the field, their rice harvest, and pests and diseases that might affect the crop harvest.

Table 1. Profile of rice cultivation activities.

Profile of rice cultivation activities	Categories	Frequencies (Respondents)	Percentage (%)
Field size	1-2 acres	56	58.9
	3-4 acres	25	26.3
	5-6 acres	6	6.3
	7 acres and above	8	8.4
Job status in rice cultivation	Main income	55	57.9
	Side job	40	42.1
Length of time in rice cultivation	< 1 year	11	11.6
	1-3 years	20	21.1
	4-6 years	20	21.1
	7-9 years	12	12.6
	> 10 years and above	32	33.7
Land status	Individual ownership	74	77.9
	Rent/ Lease	21	22.1
Rice seed management for one planting season	< Below than RM200	2	2.1
	RM201-RM400	16	16.8
	RM401-RM600	48	50.5
	RM601-RM800	19	20.0
	> RM801 and above	10	10.5
Rice yield in one season (Tons)	< 1 ton	3	3.2
	1-3 tons	61	64.2
	4-6 tons	17	17.9
	7-9 tons	4	4.2
	10 tons and above	10	10.5

4.2. Varieties of Rice Seeds Cultivated by Farmers

This section discusses the rice seed varieties used by farmers during the five seasons of rice cultivation: seasons 1/2019, 2/2019, 1/2020, 2/2020, and season 1/2021 in MADA Sungai Limau, Yan, and Kedah (Table 2).

Table 2. The rice seed varieties used by farmers during the five seasons of rice cultivation.

Rice cultivation season	Variety	Frequencies (Respondents)	Percentage (%)
Season 1/2019	MR297	65	68.4
	UKMRC-2	11	11.6
Season 2/2019	MR297	47	49.5
	MR219	13	13.7
Season 1/2020	MR297	43	45.3
	MR219	17	17.9
Season 2/2020	MR297	51	53.7
	MR303	11	11.6
Season 1/2021	MR297	55	57.9
	MR219	15	15.8

4.2.1. Seasons 1/2019

Based on Table 2, the most commonly used rice seed variety is MR297, with 68.4 percent (65 respondents). The analysis indicates that most farmers chose the MR297 rice seed variety over UKMRC-2 rice. This is because the MR297's desirable agronomic properties meet the farmers' needs due to its resistance to various diseases. According to a Malaysian Agricultural Research and Development Institute (MARDI, 2016) study, the MR297 or SIRAJ 297 rice seed variety has several advantages, like resistance to sheath blight, stem blight, and red virus disease. In addition, the MR297 rice seed variety is also moderately resistant to brown planthoppers. As a result, the MR297 rice seed variety is the preferred choice due to its higher resistance to diseases and pests.

4.2.2. Season 2/2019

The study found that the highest value was recorded in the MR297 rice seed variety, with a percentage of 49.5 percent (47 respondents). Most farmers choose the MR297 rice seed variety over the MR219 rice seed variety (Table 2). The MR297 rice seed variety is in high demand from the respondents, as the rice seed variety is said to produce quality rice and maintain the variety planted in the previous season. As a result of the MARDI (2016) study, the amylose content in rice from MR297 rice seeds was lower, at only 21.4 percent. The low content of amylose causes the texture of the rice to soften. This shows that this rice seed variety can produce high-quality rice.

4.2.3. Season 1/2020

The analysis found that the MR297 rice seed variety recorded the highest value, with 45.3 percent (43 respondents). Most respondents chose the MR297 rice seed variety compared to the MR219 rice seed variety (Table 2). This is because the rice seed variety MR297 can produce quality rice, besides contributing to a higher income. MARDI (2016) mentioned that MR297 has a higher weight for 1000 seeds per kilogram, which is 27.8 to 29.2, compared to other rice seed varieties. However, MR219 is still the preferred choice as it is categorized as a high-yield variety with 200 grains per panicle and a productivity of more than 10 mt/ha compared to other varieties introduced by MARDI. Varieties MR219 are also resistant to blast disease and bacterial leaf blight (Alias, 2002).

4.2.4. Season 2/2020

The analysis showed that the MR297 rice seed variety has the highest value, with a percentage of 53.7 percent (51 respondents), compared to the MR303 rice seed variety (Table 2). The MR297 rice seeds can produce high yields in a short time. Furthermore, the variety has a height ranging from 64.4 to 70.0cm, with a rice turnover of around 61.4 percent (MARDI, 2016). Its advantages attract farmers to use it in each rice cultivation season due to its high yield potential.

4.2.5. Season 1/2021

The analysis found that most farmers use the MR297 rice seed variety, with 57.9 percent (55 respondents) using it (Table 2). The demand for the MR297 rice seed variety is increasing as it has a short maturity period of 110 to 115 days after being sown directly in the fields and after a higher harvest (MARDI, 2016). A previous study by the Muda Agricultural Development Authority (MADA, 2021) in Sungai Limau, Yan, and Kedah, estimated that almost 80 percent of farmers used the MR297 rice seed variety compared to other rice seed varieties during the 1/2021 season.

4.3. Impact of the Use of Quality Rice Seed Varieties on Rice Cultivation Activities in the Study Area

In general, the farmers' use of quality rice seed varieties will positively impact crop productivity, thus affecting the yield of rice production. It can also improve the welfare of farmers. Table 3 shows the impact of farmers' use of quality rice seed varieties in rice cultivation for the five planting seasons in AFO F-IV, Sungai Limau Yan, Kedah area.

4.3.1. Improving the Quality and Yield of Rice Production

Based on Table 3, most respondents strongly agreed (43.2%) and agreed (52.6%) that using quality rice seed varieties can improve the quality and yield of rice production. The mean value recorded is 4.35. At the same time, the variant values and standard deviations recorded are 0.506 and 0.711. Good quality, yield potential, and stability are the main determinants of selecting varieties to introduce to farmers. The development and introduction of several high-yielding new varieties to mitigate the low resistance of certain varieties to a disease (MARDI, 2016), in addition to the growth of more uniform and stronger plants, shorter maturation duration, and ability to maximize

land use (Sariam et al., 2014), result in high potential rice yields, thus increasing the country's rice production (Ibrahim & Siwar, 2012).

Table 3. Impact of the use of quality rice seed varieties on rice cultivation activities in study area.

Impact of the use of quality rice seed varieties on rice cultivation	Scale					Central tendency		
	1	2	3	4	5	Mean	Variance	Standard deviation
Improving the quality and yield of rice production	1% (1.1)	2% (2.1)	1% (1.1)	50% (52.6)	41% (43.2)	4.35	0.506	0.711
Increased crop resistance to weather factors	1% (1.1)	1% (1.1)	8% (8.4)	70% (73.7)	15% (15.8)	4.02	0.383	0.618
Increased crop resistance	-	1% (1.1)	4% (4.2)	77% (81.1)	13% (13.7)	4.07	0.218	0.467
Higher resistance to diseases	-	2% (2.1)	5% (5.3)	75% (78.9)	13% (13.7)	4.04	0.275	0.524
Reducing the weedy rice population	1% (1.1)	-	7% (7.4)	73% (76.8)	14% (14.7)	4.04	0.317	0.563
Reducing the production input and purchase costs	2% (2.1)	3% (3.2)	10% (10.5)	74% (77.9)	6% (6.3)	3.83	0.461	0.679
Easier crop management	2% (2.1)	-	12% (12.6)	68% (71.6)	13% (13.7)	3.95	0.455	0.674
The increase in farmers' income due to higher production yields	1% (1.1)	1% (1.1)	3% (3.2)	71% (73.7)	19% (20.0)	4.12	0.359	0.599
Improving farmers' standard of living and their economic status	1% (1.1)	-	4% (4.2)	68% (71.6)	22% (23.2)	4.16	0.347	0.589

4.3.2. Increased Crop Resistance to Weather Factors

The crop's resistance to the weather also depends on using quality varieties. This is because the conversion of quality varieties for the next crop season can increase the resilience of rice crops in the event of weather changes. Most farmers agreed (73.7 percent) or strongly agreed (15.8 percent) with this statement. The mean value recorded is 4.02. The variant values and standard deviations are 0.383 and 0.618 (Table 3). This is also acknowledged by researchers, including Mokhtar et al. (2012), Dar et al. (2021), Ahmad et al. (2022), Harun (2015), and Sariam et al. (2014), who found that developing varieties suitable for the local environment can reduce the deterioration of yields due to uncertain weather conditions and deterioration in soil quality to ensure food safety (Azmi et al., 2012; Che et al., 2016).

4.3.3. Increased Crop Resistance

The study found that farmers sometimes change rice varieties for the next planting season to improve the durability of rice plants. Most respondents (81.1%) agreed with the statement, while 13.7 percent strongly agreed. The mean value obtained is 4.07, with variant values and standard deviations of 0.218 and 0.467, respectively. This aligns with studies by Akos et al. (2019), Dar et al. (2021), and Ahmad et al. (2022) that found that selecting quality rice seed varieties can increase crops' resistance to abiotic and biotic stress. Increasing crop resistance to various stresses positively impacts productivity, thus increasing farmers' income and food security.

4.3.4. Higher Resistance to Diseases

Most respondents agreed (78.9%), and 13.7% strongly agreed, that changing to quality rice seed varieties by farmers for the next planting season can help control diseases. Only 2.1% disagreed with the statement. The mean value is 4.04, with a variant value of 0.275 and a standard deviation of 0.524 (Table 3). The use of quality varieties can protect crops from certain diseases despite their moderate resistance to other diseases. Bobihoe (2021), Elixon

et al. (2012), MARDI (2016), and Zainudin et al. (2012) found that farmers prefer new varieties resistant to some common crop diseases to lower the risk of diseases and increase production yields.

4.3.5. Reducing the Weedy Rice Population

Weedy rice is a weed that poses a major problem for many farmers, specifically in weed management, due to the illegal use of rice seeds. According to MARDI (2018), the invasion of weedy rice will result in a significant decline in rice yield and increased weed management expenses (Rosnani et al., 2013). The results showed that 76.8 percent (73 respondents) of respondents agreed, and 14.7 percent strongly agreed that using quality rice seed varieties could reduce the windy paddy population. One respondent strongly disagreed (1.1%), and 7 disagreed. The mean values recorded are 4.04, with a variant value of 0.317 and a standard deviation of 0.563 (Table 3).

4.3.6. Reducing the Production Input and Purchase Costs

The use of quality varieties can lead to healthier crops. These varieties have demonstrated higher crop resistance to pests, diseases, and weeds. It can also reduce production input costs due to the lesser use of chemical pesticides and fertilizers (Rosmiza et al., 2021; Sutardi et al., 2022). This aligns with the International Rice Research Institute (IRRI) (2022), which found that the cost of purchasing fertilizer is reduced by reusing livestock manure as organic fertilizer for rice crops because of the expansion of animal husbandry activities. This farming activity impacts the profits farmers earn through the increase in yields from using high-yield varieties in rice cultivation. In the study area, the majority of respondents agreed with the percentage value, strongly agreed (6.3%), and agreed (77.9%) with the fact that the cost of production input decreased with the use of quality varieties. Meanwhile, 10.5 percent of the respondents slightly disagreed, 3.2 percent disagreed, and 2.1 percent strongly disagreed. The mean value recorded is 3.83. At the same time, variant values and standard deviations are 0.461 and 0.679 (Table 3).

4.3.7. Easier Crop Management

Higher resistance to various pests, diseases, weeds, and weather conditions allows the cultivation of healthier and easier-to-manage crops. This will reduce farmers' burdens in crop management, in line with the studies by Amzah et al. (2013) and Nuryanto (2018). The analysis found that the statement 'crop management becomes easier with the use of quality varieties' recorded a mean of 3.95, a variant value of 0.455, and a standard deviation of 0.674. Out of 71.6 percent (68 respondents), 68 responded with agree, and 13.7 percent (13 respondents) strongly agreed with the statement. Meanwhile, only two, or 2.1 percent, of the respondents strongly disagreed with the statement (Table 3). In this light, each rice seed variety produced by the Malaysian Agricultural Research and Development Institute (MARDI) through R&D has its own agronomic characteristics in terms of production, resistance to pests and diseases, and maturation duration.

4.3.8. The Increase in Farmers' Income Due to Higher Production Yields

The study found that 74.7 percent (71 respondents) agreed and 20.0 percent (19 respondents) strongly agreed with the statement that using quality varieties could increase farmers' income. Only one respondent (1.1%) strongly disagreed, and another disagreed with the statement. The mean value obtained is 4.12, the variant value is 0.359, and the standard deviation is 0.599 (Table 3). This study's results align with those of Assaye et al. (2022), Islam (2018), and Sariam et al. (2014), which found that using quality varieties and verifying rice's genetic authenticity can lead to high productivity and contribute to higher farmers' income.

4.3.9. Improving Farmers' Standard of Living and Their Economic Status

As shown in Table 3, most respondents (71.6%) agreed, and 23.2% strongly agreed with the statement "Farmers' standard of living and economy have improved after using quality varieties". Meanwhile, 1 or 1.1% of the

respondents responded with highly disagree, and 4.2% disagreed with the statement. The mean value recorded is 4.16. At the same time, the variant values and standard deviations recorded are 0.347 and 0.589, respectively. This coincides with a study by Zaman, Othman, and Hamid (2014), Islam (2018), Assaye et al. (2022), and the International Rice Research Institute (IRRI) (2022), which found that farmers' well-being has increased in tandem with the increase in production and household income, healthy eating (Asian Development Bank, 2018), and closing the poverty gap.

5. RECOMMENDATIONS

The policy on using quality rice varieties among farmers should be strengthened to ensure the aspirations for higher yields, better farmers' well-being, and food security can be realized. This will guarantee the country's food security by reducing imports and production input costs, ultimately eradicating poverty among farm households. Existing and new policies should highlight the need for better seed availability, cost reduction, optimal farmland use, formal education, and farmer income generation. In this regard, cooperation between agricultural institutions and non-governmental partners (NGPs) in organizing expansion programs and increasing farmer access should be enhanced.

Interventions to increase the use of quality rice varieties should focus on increasing farmers' access to agricultural information, markets, expansion services, production inputs, and willingness to use quality varieties. Research on agricultural problems and local farmers' concerns, as well as the degree of knowledge, communication skills, and knowledge of development agents, are crucial to boosting farmers' confidence in agricultural change and reform initiated. Development agents should provide farmers with extensive training through official and informal education, emphasizing the positive effects of a reform implemented through demonstration sites, seminars, and courses. Undoubtedly, intensive extension programs focused on education and agricultural development services will increase farmers' awareness, access, and willingness to use high-quality novel varieties.

The development and commercialization program of high-yield varieties should meet farmers' preferences. The government should prioritize the improvements to the rice seed system to increase seed availability, accessibility, and affordability to farmers as a measure to address the insufficiency and delay in the seed supply. There is a need to provide farmers with easy access to services to increase their trust and acceptance of changes and reforms in the current system. It is important to note that every action or change farmers make will affect farm households' income level and well-being. Therefore, the government must provide a conducive environment to increase farmers' access to quality seeds.

6. CONCLUSION

The proliferation of innovation and technological advancements within the agricultural domain has led to a notable enhancement in rice productivity through the introduction of several high-quality rice seed variants. Farmers in Malaysia are advised to refrain from producing rice seeds that have not been certified or registered. In addition to the dangers of blending with weed kinds, contaminating healthy seeds, and climate change, this is done to prevent uneven rice development, which will result in a 70 percent yield reduction. Quality varieties have a higher level of assurance in terms of their development and output, specifically in relation to the quantity of stems, rice seeds, and stem length. Moreover, they possess a notable resilience against collapse and demonstrate resistance against many diseases and pests. The use of high-quality seeds has the potential to enhance agricultural yield, diminish the expenditure on production inputs, facilitate crop management, augment farmers' income, and ultimately improve their overall well-being. Additionally, this phenomenon carries considerable significance for enhancing the nation's food security and mitigating poverty levels among agricultural households. This effort contributes to the transformation of the agro-food business, aligning it with the objectives of the National Agro-food Policy, while enhancing its competitiveness and sustainability.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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