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FACTORS EFFECTING PADDY PRODUCTIVITY IN THE MADA REGIONS, MALAYSIA

[1]Kirttana Kalimuthu & [2]Shri Dewi Applanaidu
[1&2]School of Economics, Finance and Banking,
College of Business, Universiti Utara Malaysia

[1]Corresponding author: kirttana.kirthi@gmail.com

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ABSTRACT

Rice commodity is becoming increasingly important for most countries worldwide, particularly those where rice is the main staple meal. This study examines the socioeconomic attributes of farmers, their perspectives on management practises, and the implementation of paddy machinery technology in the four MADA (Muda Agricultural Development Authority) regions in Malaysia. The study aims to determine the main factors effecting paddy productivity in the MADA regions. Primary data was collected from paddy farmers in the four MADA zones using a standardised questionnaire. The data was collected from 673 respondents from four regions of MADA. The analysis employed both descriptive statistics and regression analysis. The results indicate that variables such as land area, selection of paddy planting as the primary occupation, increased time spent on paddy farms, gender, and the educational background of farmers have a significant impact on paddy productivity in the MADA regions. The findings also show that, only a small percentage of respondents (6.2%) followed the crop schedule, and 93.8 percent of them were late. The utilisation of machinery in paddy cultivation achieved the following results: nine farmers achieved a success rate of 85.71 percent, while a majority of farmers (662 farmers) achieved a 71.43 percent utilisation rate, with one farmer earning the lowest usage rate of 57.14 percent. In conclusions the study has found that it is imperative to promote the use of management practises and advanced machinery technologies among paddy farmers to effectively increase productivity.

Keywords: Paddy, management practices, machinery, socio-demographics, technology.

INTRODUCTION

Rice is a prevalent staple in Malaysia and holds great cultural importance. The Malaysian people frequently include the grain in their diet, either by consuming cooked rice or informally through the ingestion of rice flour. Rice is a prominent component of the Malaysian diet, since the average Malaysian consumes 87.9 kilogrammes of rice per year (KRI, 2019). Malaysia›s per capita rice consumption, as evidenced by the available data, is above the global average of 54.6 kg/person. These beats both India›s consumption of 69.0 kg/person and China›s consumption of 77.9 kg/person (KRI, 2019). Empirical data suggests that a significant majority of Asians, specifically nine out of ten individuals, regularly partake in the consumption of rice. Rice is a valuable dietary staple due to its abundance of nutrients, vitamins, minerals, and complex carbohydrates.

In the history of Malaysian economics, the agriculture sector contributes to the GDP of the nation and significantly contributes to the development of rural areas. The agriculture sector accounted for 30.8 percent of the GDP in 1970, the largest percentage of any sector (Alam et al., 2010). Following that, agriculture became the second-biggest industry in 1990, accounting for 18.7 percent of the national GDP. Furthermore, the agriculture business is becoming a more important sector in national economies because it employs a large number of people. The shift of Malaysia›s economy from an agrarian to an industrialised one has exerted a significant impact on agricultural production, hence reducing its significance in the rural regions. Statistics that show a 2.5 percent seasonally adjusted decline in the agriculture sector by the first quarter of 2023. At the same time, Malaysian statistics show that the agriculture sector rose modestly by 0.9 percent in this quarter, owing to improved performance in the oil palm (3.4%) and other agriculture (2.6%) sub-sectors (DOA, 2023). Malaysia›s agriculture sector generated around 8.93 percent of the national GDP in 2022 (DOA). However, in 2023, the agriculture sector›s contribution to the national GDP decreased to approximately 7.8 percent (DOSM, 2024).

The enhancement of rice productivity has emerged as a pivotal concern in Malaysia›s food security and the provision of staple foods within the context of the contemporary global economy. The current economic environment has prompted the Malaysian government to adopt a cautious approach and increase their awareness regarding the growing population and the corresponding need for rice cultivation. Malaysia relies on other nations to ensure food security as it progresses towards industrialization. According to the Food and Agriculture Organisation (FAO) in 2018, Thailand and Vietnam play significant roles in the global rice export market, whereas countries such as Malaysia, Indonesia, and the Philippines depend on imports to meet their domestic rice requirements.

The COVID-19 epidemic is posing significant hurdles, with billions of people facing food and nutrition insecurity. During this crisis, the International Rice Research Institute (IRRI) is dedicated to providing nutritional and food security via rice-based agro-food schemes (IRRI, 2021). In a similar vein, Malaysia is actively expanding state involvement in the agricultural sector as a means to safeguard the country›s food security, with particular emphasis on the rice industry. The MAFS and other institutions are working to boost rice productivity in Malaysia, particularly in the Muda Agricultural Development Authority (MADA) regions, which have been recognised as the nation›s rice bowl.

Paddy farmers in MADA use a variety of technologies and management practices to boost paddy productivity, including small harvesters, new rice varieties, high-tolerance tractors, drones, and trans-planters. However, MADA is still unable to meet the 10 metric tonnes per hectare target. According to several studies, the primary factors influencing paddy yield include socioeconomic factors, management practices, adoption of technology, usage of machinery, environmental conditions, seed quality, pets, and diseases (Tan et al., 2021; Ambali et al., 2021; Mao et al., 2021). A study on the factors influencing MADA paddy production is critical to achieving the 10 metric tonnes per hectare paddy productivity goal and improving the livelihoods of MADA paddy farmers. Technological interventions, mostly through mechanisation and fertiliser application, are regarded as important contributors to paddy yield. Therefore, there is a need to identify the adoption of technology by using machinery among MADA paddy farmers. It is crucial to conduct a comprehensive study on the various factors that influence paddy yield in Malaysia, with a special focus on the MADA regions, which have been widely recognised as the primary rice-producing areas in the country. This study primarily focuses on the socioeconomic characteristics of farmers, their attitudes towards management practices, and the adoption of paddy machinery technology in the four MADA regions.

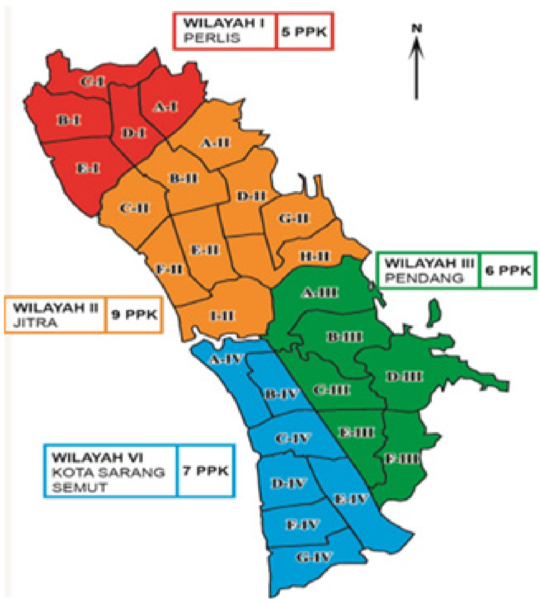
This paper is organised into the following five sections: (i) an introduction that describes the topic, problems, significance of the study, and MADA overview; (ii) a literature review that reviews previous empirical studies related to paddy production; (iii) methodology that describes the method used to achieve the objective, data collection, and analytical tools used; (vi) results and discussions; and (v) conclusions.

MADA at a Glance

Throughout the course of development in rice agriculture, the MADA has effectively achieved its objectives of enhancing the productivity of rice farmers and addressing various obstacles encountered in the rice farming region throughout the previous twenty years. MADA faces several challenges in developing the rice sector in the MUDA areas, such as paddy land development, climate change, responsiveness to technology, and access to technology networks. MADA is one of the agencies under Malaysia›s Ministry of Agriculture and Food Security (MAFS). MADA was developed to address and run the irrigation plan, which is the country›s greatest rural development project, and was initiated under the previous Malaysia Plan (MADA, 2017). The objectives are to increase the well-being of a vast number of villagers while vastly overestimating revenue for the country›s needs (MADA, 2023). The MADA principles play a crucial role in the enhancement of the rice sector, facilitating its transition to a contemporary, proficient, sustainable, and competitive state.

Figure 1

Map of Four Regions in MADA, Malaysia



Note. https://www.MADA.gov.my 230523

Rice cultivation in Malaysia occurs in both granary and non-granary regions, contributing to its structural development. The government designates the granary area as the principal paddy production region; the non-granary region is the exact opposite (Rahmat et al., 2019). There are eight main granary areas in Malaysia, namely Muda Agriculture Development Authority (MADA), Kemubu Agriculture Development Authority (KADA), Barat Laut Selangor Integrated Agriculture Development Area (Barat Laut Selangor IADA), Penang Integrated Agriculture Development Area (Penang IADA), Kerian

(KETARA), Kerian Sungai Manik, Seberang Perak, and Kemasin-Semerak. The MADA region is widely acknowledged as the largest among the eight granary districts, and it holds the esteemed reputation of being the central hub for rice cultivation in the nation.

The MADA is responsible for the management and supervision of a total land area spanning 130,282 hectares. Within this expanse, approximately 100,685 hectares are dedicated to the cultivation of rice. The MADA rice crop is geographically divided between two states, namely Kedah with an area of 82,968 hectares and Perlis with an area of 17,717 hectares. The MADA area comprises two states, namely Kedah and Perlis, together with the following four distinct regions: 1) the Perlis Region, 2) the Jitra Region, 3) the Pendang Region, and 4) the Kota Sarang Semut Region. The present average paddy yield of MADA ranges from five to seven tonnes per hectare. Paddy cultivation has improved rapidly in the last decade as a result of several innovation programmes and the use of agricultural machinery. The MADA is a crucial entity in ensuring the preservation of food security within Malaysia (Hussin & Mat, 2013).

Table 1

MADA Total Area in Malaysi

MADA regions	MADA area by regions (hectares)
	MADA's current area
Region I: Perlis	20,073
Region II: Jitra	32,595
Region III: Pendang	22,681
Region IV: Kota Sarang Semut	25,336
MADA total area	100,685

Note. Sourced from Laporan Tahunan MADA, 2016.

The Perlis region has a paddy farming area of 20,073 ha. The remaining regions II, III, and IV paddy farming areas are 32,595 ha, 22,681 ha, and 25,336 ha, respectively. The significance of MADA lies in its extensive land area, which positions it as the main driver of the production of rice (KRI, 2019). The administration of the MADA implemented a division of the entire cultivated land into 27 smaller units known as the *Persatuan Peladang Kawasan (PPK)*. MADA management has its own central office structure in each PPK and serves as a route for extension programs. According to MADA management, to maximise cost savings through economies of scale, the extension programme strategy must be combined with effective farm management (Omar et al., 2019). From the perspective of technology adoption among MADA paddy farmers, large-scale paddy planting (PPSB) and SMART large-scale paddy field (SMART SBB) programs were introduced in 2023 by the management. The programs will be able to witness the introduction of new agricultural technologies and finance options (Bernama, 2023).

THEORETICAL BASIS

Different theories exist in the literature regarding paddy production and the factors that influence it. This study builds upon the established theoretical framework of prior research to assess the various elements that influence paddy productivity. The function of paddy farmers and technology adoption in MADA paddy regions were clearly outlined in the production theory and the diffusion of innovation theory. This study examines the factors influencing paddy productivity in Malaysia's MADA paddy regions, focusing on production theory. The research confirms classical economics' 18th-century findings that land, labour, and capital are crucial in production. Cobb-Douglas (1928) clarified that the quantitative factors of labour and capital were necessary for generating goods, while describing the connections among labour, capital, and output. Ibrahim and Mook (2014) interviewed 2,884 paddy farmers, concluding that labour was the main factor in production. The socioeconomic status of the farmer and the size of his or her field effected the yield of paddy crops. Other studies have conclusively shown that labour and land size would increase output (Jamaludin et al., 2010; Siwar et al., 2014; Firdaus et al., 2020).

Innovation refers to the introduction of new concepts, behaviours, or products, often aimed at improving service or product quality. The Diffusion of Innovation (DOI) Theory, which Rogers developed in 1962, explains how concepts or products gain popularity and spread throughout a population or social system over time. This theory is particularly relevant in the agricultural sector, particularly in the paddy industry. A study by Mannan and Nordin (2014) found a significant correlation between innovative qualities and the adoption of new technology, which significantly enhances rice yield and paddy quality, especially in granary locations.

INSIGHTS FROM LITERATURE

This section highlights the empirical background performed on analysing the critical factors of paddy productivity in MADA regions. The literature review was further divided into the following three parts: farmer's socio-demographics, farmer's attitude towards management practices and technology adoption of farmers on paddy productivity.

Farmer's Socio-demographics

The socio-demographic profile of paddy farmers encompasses various characteristics, including gender, age, educational attainment, marital status, household size, farming experience, knowledge, and income. The literature is rich with studies that have proved empirically that farmer socio-demographics have played a major role in paddy output (Nordin et al., 2014; Siriwardana & Jayawardena, 2014; Moses et al., 2019). In their study, Moses et al. (2019) employed descriptive analysis and the multiple regression method to demonstrate that male farmers in Benue State, Nigeria, exhibit a higher level of involvement compared to their female counterparts. According to a study by Ibrahim and Mook (2014), demographic traits and behaviours had a significant impact on paddy output. Specifically, the study revealed that male farmers tended to achieve higher yields compared to their female counterparts. Furthermore, the number of years of experience was identified as the most crucial determinant of paddy output. The study by Kajenthini et al. (2019) used cross-sectional data to examine the relationship between age and engagement in paddy farming. Their findings revealed that older farmers showed higher levels of involvement in this agricultural practice. In contrast, the study conducted by Alam et al. (2011) revealed that there was no significant impact of age and gender on paddy productivity.

In the Malaysian context, Nordin et al. (2014) conducted a study on the dissemination of novel technology among rice farmers. Their findings indicated that a significant proportion of farmers, specifically 67.3 percent, held the belief that the adoption of new fertiliser will enhance the overall competitiveness of farmers within the industry. Additionally, this study has also suggested that there is a need for further educational programmes that focus on fertiliser consumption. The significance of farming experience cannot be understated, as it plays a crucial role in enhancing the productivity of paddy farming through the implementation of innovative techniques and the acceptance of new practices. Prihtanti (2016) highlighted the fact that placing a strong emphasis on innovation and the adoption of new practices has a significant impact on the productivity of paddy farming. Hence, it is imperative to investigate the socio-demographic profiles of rice farmers in the MADA regions in order to figure out the productivity of paddy cultivation in those regions.

Attitude towards Management Practices

The literature on paddy farming technology has grown in recent years (Adnan et al., 2017; Siddick, 2019; Mao et al., 2021). Agriculture innovation technology has long been linked to financial growth and productivity. Several studies have shown that management approaches improve paddy cultivation (Nazuri and Man, 2016; Adnan et al., 2017). Nazuri and Man (2016) found that farmers' good MADA practices on paddy seed varieties promote rice farming knowledge and technological advancement. Abas (2016) examined how managerial practices effect paddy self-reliance. The researcher found that managerial subsystems, self-owned seeds, natural fertiliser, and farm labour effected paddy self-reliance. Mohamed et al. (2016) evaluated paddy farmers' sustainability practices in the Sungai Petani district, Kedah, Malaysia's granary lands. The study studied 80 paddy farmers in the sub-granary regions of the Sungai Petani district in Kedah, Malaysia, who used sowing, fertiliser application, and insect and pest management. The survey found that 80 percent of farmers used unsustainable paddy cultivation methods. On a scale of 0 to 100, a score below 40.0 indicated low sustainability. This study also had also proposed improving rice farmers' sustainable paddy growing methods to boost yield. The research provided so far shows that most farmers in developing nations are aware of the latest agricultural techniques to optimise production and minimise environmental damage. Authorities involved in paddy management must advise farmers on the latest advances and management strategies for efficient and successful production in a clear and informative manner.

Technology Adoption

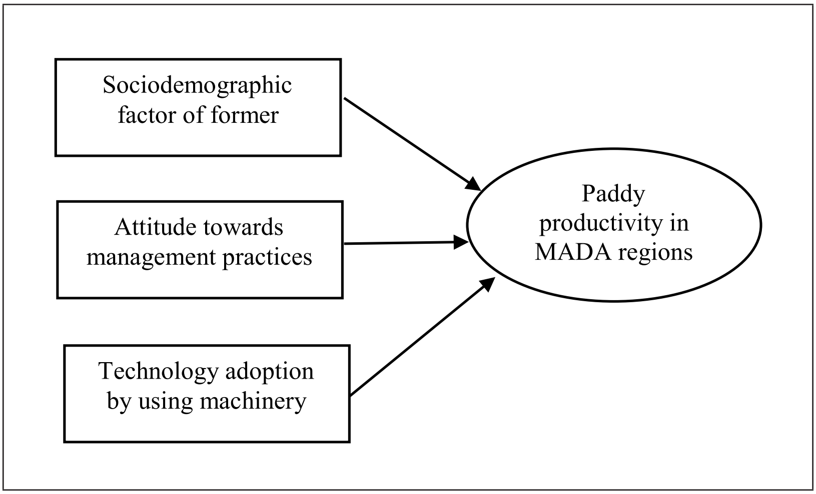
Modern technology in rice cultivation can help farmers maximise crop yields and promote sustainable development. Studies have shown that family workers, weedicide use, fertiliser use, and farm size positively effected rice yield (Abdulai et al., 2018). Large-scale Chinese farmers were more likely to use green technology than small-scale farms, as they could profit more from green agricultural technologies (Mao et al., 2021). Likewise, Siddick (2019) has acknowledged that rice yield gaps could be closed using current technology to enhance paddy productivity. According to Venkatesan et al. (2016), using good paddy growing techniques can boost farmers' income from Rs. 15,000 to 20,000/ha in Kolli Hills, Tamil Nadu, India. Adnan et al. (2017) evaluated Malaysian rice farmers' adoption of green fertiliser technology, and found two key impediments: economic and non-economic. Nordin et al. (2014) found that farmers were proactive in learning about new fertiliser innovations, especially for rice agriculture. Rahmat et al. (2019) provided the most substantial empirical analysis of Malaysian paddy technology, highlighting the use of agro technology to boost paddy productivity.

Machinery Usage

Industry Revolution 4.0 technology is being implemented to improve productivity and quality in the agriculture sector, particularly in the paddy, oil palm, rubber, and pineapple industries. Mechanisation technology can enhance crop quality and quantity, leading to increased productivity (Baharudin & Waked, 2021). However, there is limited literature on mechanisation in paddy farming in Malaysia. Studies have shown that farmers with superior skills, higher education levels, and competency in the use of agricultural equipment were more likely to use mechanisation (Muazu et al., 2014). In Malaysia, spraying is the most demanding operation, with a significant need for mechanisation, to as much as 80.76 percent (Muazu et al., 2014). Studies have also found that the timely execution of operations and reduced cultivation expenses were crucial for enhancing rice yield and overall productivity. In Nigeria, factors such as education, extended visits, and access to machinery play a significant role in farmers' adoption of mechanisation practices (Owombo et al., 2012). Similarly, Paman et al. (2018) found that farmers in the Kampar area of Indonesia preferred smaller agricultural machinery, such as power tillers, water pumps, powered threshers, and rice grinding units. Public financial support and private sector cooperation are essential in encouraging small-scale farmers to use farm machinery. Studies have shown that mechanisation has made paddy cultivation easier, reduced labour costs, saved time and human drudgery, and increased crop intensity. Therefore, it is recommended that rice farmers use more paddy machinery to produce more paddy with higher yields.

Theoretical Framework

Figure 2 Shows the Theoretical Framework of the Present Study, which has been Adapted and Modified from Dang and Pham, 2022



The theoretical framework was developed with the belief that the selected variables would have an impact on the paddy productivity of MADA regions. Within this framework, the following factors were identified: socio-demographic profiles of farmers, their attitudes towards management practices, and their adoption of technology. These elements have been identified as potential contributors to paddy productivity and known as independent variables, while paddy productivity in MADA regions is the dependent variable.

METHODOLOGY

Data

This research has adopted a quantitative approach with a cross-sectional research design to achieve its aim. The population size of the MADA area at the time of the study was 100,685. Based on the size of the land area of the four MADA regions, the sample selected for the study comprised the 673 respondents proportionally distributed among these four regions. The sample within each of the region was selected randomly. The study was carried out using a well-structured questionnaire comprising survey questions which had been developed in consultation with MADA officers, who had provided assistance and advice. During the process of data collection, the author follows a structured survey questions with the participants. Survey questions helped to gather information from a targeted group efficiently (Alam et al., 2011).

The questionnaire was designed to accommodate respondents from various ethnic backgrounds by being made available in Malay, a language that all participants can read and write. The survey questions comprised three components. The initial portion dealt with the socio-demographic background of farmers, which included their gender, age, primary occupation, educational attainment, and family labour involvement. In the subsequent section, the farmers were requested to provide their response to the implementation of management practices, including their engagement in fieldwork for a single day and adherence to the timetable devised by the MADA management. The final section covered seven different types of machinery used by MADA farmers in the process of paddy production.

Analytical Techniques

In order to analyse the data, descriptive analysis was extensively employed in the description of the socio-economic characteristics, which included the tabulation of the frequencies, percentages, mean, maximum, and standard deviations. Farmer attitudes about rice farming management practices and machinery usage were also described using the descriptive methodology. Multiple regression analyses were performed to determine factors that influence the adoption of technology and other factors that effect paddy productivity. The explanation of the model is as follows in Equation 1 below:

$$PP_I = \alpha_1 + \beta_1 GEN_1 + \beta_2 AGE_2 + \beta_3 EDU_3 + \beta_4 OCC_4 + \beta_5 LAN_5 + \beta_6 TME_6 + \beta_7 COM_7 + \beta_8 LAB_8 + \beta_9 FSEB_9 + \beta_{10} NPK1_{10} + \beta_{11} NPK2_{11} + \beta_{12} MECH_{12} + \mu_I \quad (1)$$

Where:

α = Constant
μ = Error Term
$\beta_1 - \beta_{13}$ = Coefficients of variables
PP = Paddy productivity
GEN = Gender
AGE = Age
EDU = Education Level
OCC = Main Occupation
LAN = Land Size
TME = Time in Field
COM = Crop Schedule Compliance
LAB = Family labour
FSEB = Fertiliser SEBATIAN
NPK1 = Fertiliser NPK 1
NPK2 = Fertiliser NPK 2
MECH = Mechanisation

RESULTS

The main objective of this study is to investigate the impact of various socio-demographic attributes of paddy farmers on rice production, namely their attitudes towards management practices, and their adoption of paddy technology by using machinery to enhance production levels in the MADA regions. This section of the study examines the socio-demographic characteristics of farmers, as well as their attitudes towards management practices and the adoption of mechanical technology in rice farming within the MADA regions. The findings of the data analysis are presented and discussed in this section. The analysis of the results is categorised into following four distinct categories: the socio-demographic attributes of farmers, the attitudes of farmers towards management practices, the adoption of paddy technology, and the use of paddy machinery.

Socio-demographic Profiles of MADA Paddy Farmers

The results of the descriptive analysis on the demographic profile of respondents, such as gender, age, educational level, and main occupation, were discussed in this section. Paddy farmers' socio-demographics were collected from four MADA regions. Table 1 presents the demographic profile of paddy farmers in these MADA regions.

Table 2

Demographic Characteristics of the MADA Farmer

Characteristics	Classifications	Frequency	Percentage
Gender	Male	540	80.2
	Female	133	19.8
Age	21 - 30	11	1.6
	31 – 40	33	4.9
	41 – 50	100	14.9
	51 and above	529	78.6
Education Status	Degree/Diploma	18	2.7
	Middle School	502	74.6
	Skills Institutions	3	0.4
	Primary School	145	21.6
	No Education	5	0.7
Main Occupation	Paddy	622	92.6
	Other Crops	8	1.2
	Livestock	31	4.4
	Services	12	1.8
Land Area	0 – 0.99	353	52.5
	1 – 1.99	252	37.4
	2 – 2.99	60	8.9
	3 – 3.99	6	0.9
	4 >	2	0.3

(continued)

Characteristics	Classifications	Frequency	Percentage
Time spent in the field	Less than 2 hour	148	22.0
	2 – 4 hour	523	77.7
	5 – 7 hour	1	0.1
	More than 7 hours	1	0.1
Crop schedule compliance	Follow the schedule	42	6.2
	Late schedule	631	93.8
Family Labour	0 Person	516	76.7
	1 Person	153	22.7
	2 Person	4	0.6
Paddy yield	< 1000	1	0.1
	1001 – 3000	3	0.4
	3001 – 5000	46	6.8
	5001 – 7000	586	87.1
	>7000	37	5.5

According to the statistics presented in Table 2, it is evident that a significant proportion of paddy farmers in the MADA region were male, accounting for 80.2 percent of the total, while women make up only 18.2 percent. In relation to the age distribution of paddy farmers, a significant proportion (78.6%) falls into the age category of 51 and above, while only 1.6 percent represents individuals aged between 21 and 30. A considerable proportion of farmers residing in the MADA districts, namely 502 individuals, have attained a middle school education, whereas a mere 18 respondents have successfully obtained a degree as their highest level of educational achievement. The primary occupation of the agricultural workers is the cultivation of paddy, which constitutes 92.6 percent of the overall agricultural activities. Approximately 52.6 percent of paddy farmers possess paddy land measuring less than one hectare. A small 0.2 percent of paddy farmers within the MADA zones possess paddy land over 4 hectares in size.

Furthermore, the average paddy productivity of the respondents was recorded as 5977.42 kg/ha, whereas the maximum paddy productivity was reported to be 9533.3 kg/ha. The minimum paddy productivity 984.37 kg/ha shows that, there is wide gap between highest paddy productivity and lowest paddy productivity in MADA area. This corroborates the findings in a study by Jun et al. (2010), which suggests that productivity varies across regions and has a huge gap. Following that, the average age of paddy farmers in the MADA region was 59, which means that there is a majority of ageing farmers in MADA area. In order to investigate the various forms of fertiliser usage and their respective quantities in paddy farming, three primary categories of fertiliser usage were assessed. Table 3 illustrates a significant disparity between the highest and lowest levels of fertiliser utilisation. The significant disparity in fertiliser use indicates the problem of inefficiencies in its application. These inefficiencies might arise from various factors, including but not limited to differing management practices, faulty evaluation methods, or variances in soil conditions.

Table 3

Summary Statistics

Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Productivity (Kg/Ha)	673	984.37	9533.33	5977.42	813.29
Age	673	23	97	59.74	12.19
Land Area	673	0.06	6.19	1.05	0.70
Fertiliser 1 (SEBATIAN)	673	10.0	1280.0	217.39	145.64
Fertiliser 2 (NPK 1)	673	0.0	420.0	69.07	49.74
Fertiliser 3 (NPK 2)	673	15.0	1075.0	181.99	122.45

Descriptive Analysis of Paddy Farmer Attitudes towards Management Practices

Table 4 illustrates the attitudes of paddy farmers toward management practices.

Table 4

Farmer Attitudes towards Management Practices

Management Variable		Frequency	Percent
Crop Schedule Compliance	Follow the Schedule	42	6.2
	Late Schedule	631	93.8

(continued)

Management Variable		Frequency	Percent
Time in the Field (Daily)	<2 Hours	148	22
	2-4 Hours	523	77.7
	5-6 Hours	1	0.1
	6 - > 7 Hours	1	0.1
Fertiliser 1 (SEBATIAN)	<100	167	24.8
	101-200	187	27.8
	201-300	189	28.1
	301-400	59	8.8
	401-500	46	6.8
	501-600	16	2.4
	601-700	3	0.4
	>700	6	0.9
Fertiliser 2 (NPK 1)	<100	555	82.5
	101-200	110	16.3
	201-300	7	1
	401-500	1	0.1
Fertiliser 2 (NPK 2)	<100	235	34.9
	101-200	221	32.8
	201-300	131	19.5
	301-400	57	8.5
	401-500	20	3
	501-600	5	0.7
	601-700	3	0.4
	>700	1	0.1

Table 4 also provides a descriptive analysis of the attitudes of paddy farmer towards management practices. As can be seen from Table 4 above, compliance with the planting schedule, paddy farmer total time spent in the field, and fertiliser type and usage were analysed. The results obtained from the descriptive analysis of the use of fertilisers show that there were three types of fertilisers used by paddy farmers in the MADA regions. SEBATIAN fertiliser was used as the first fertiliser application, followed by NPK1 and NPK2, respectively. There were 24.8 percent of paddy farmers who applied less than 100 kg of SEBATIAN fertiliser, while 28.1 percent applied 201 kg to 300 kg of SEBATIAN fertiliser.

The mean quantity of the second-stage fertiliser NPK 1 applied was 69.07 kg, while the maximum was 420 kg. In examining the study sample, it was found that 82.5 percent of farmers applied less than 100kg, followed by 16.3 percent applying between 101 kg and 200 kg. The third fertiliser application was NPK 2, and the mean quantity of fertiliser use was 181.99 kg, while the minimum is 15kg. The maximum score for this fertiliser was 1075 kg. When it comes to crop schedule compliance, only a small percentage of respondents (6.2%) followed the crop schedule, and 93.8 percent of them were late. It can be seen from Table 4 above that the majority of the paddy farmers spent 2 to 4 hours in the paddy field daily. About 22 percent of farmers spent less than 2 hours on a daily basis. This was followed by only 1 percent of paddy farmers who spent more than 6 hours daily in the paddy field.

Adoption of Paddy Technology among MADA Farmers

Table 5

Regression Results

Average Productivity	Description	Coef.	Std. Error	t	Sig
(Constant)		3.690	0.652	5.659	0.000
Land Area	Hectare (Ha)	-0.002	0.034	-0.055	0.050
Gender	1 = Male, 0 = Female	-0.106	0.038	-2.781	0.006
Age	1 = Young, 0 = Old	-0.012	0.025	-0.473	0.636
Main Occupation	1 = Paddy, 0 = Others	0.053	0.019	2.836	0.005
Education	1 = Degree, 0 = Lower	0.048	0.019	2.499	0.013
Time spent in field in one day	Time spent in fam daily	0.100	0.042	-2.400	0.017
Compliance	1 = Complied, 0 = Not	-0.096	0.066	-1.441	0.150
Fertiliser SEBATIAN	Kg	-0.001	0.001	-0.950.	0.343
Fertiliser NPK 1	Kg	0.000	0.001	-0.348	0.728
Fertiliser NPK 2	Kg	-0.001	0.001	-1.169	0.243
Mechanisation	Scale 1-7	0.057	0.060	-1.437	0.145

The relationship between input utilisation, land area, mechanisation, use of fertilisers SEBATIAN, NPK1, and NPK2 revealed that only land area had a significant impact on paddy productivity. However, research has demonstrated that the duration of time spent on the farm each day, when employing normal management practices, has had a significant and beneficial impact on paddy yield. More time spent in the field daily had increased paddy productivity in the MADA regions. Also, among the socio-demographic factors, the main occupation and education were found to be statistically significant. Being engaged in the paddy sector as the main occupation has impacted productivity significantly. According to the statistical analysis ($p = 0.013$), having a higher level of education has had a significant positive impact on production (0.048).

Besides, it appears that complying to the management schedule did not have a substantial effect on productivity. This could be attributed to the inefficiency of paddy farmers in their farming operations. Various types of fertilisers did not seem to have substantial effects on productivity. The unexpected results may be attributed to the MADA farmers' improper application technique of fertilisers in paddy growing. This finding is aligned with the findings in studies conducted by Feilong et al. in 2023 and Sigit et al. in 2021, which concluded that the use of various types of fertilisers did not have a significant impact on rice output. An increased level of mechanisation has a beneficial effect on productivity ($\beta = 0.057$), but it is not statistically significant at standard levels ($p = 0.145$).

Multicollinearity Test

Table 6

Test Results for the Multicollinearity Assumption of the Paddy Production Model

Model	Tolerance	VIF
(Constant)		
Land Area	0.369	2.708
Gender	0.962	1.040
Age	0.891	1.122

(continued)

Model	Tolerance	VIF
Main Occupation	0.920	1.087
Education	0.768	1.302
Use of time in field in one day	0.695	1.440
Compliance	0.853	1.173
Fertiliser SEBATIAN	0.156	6.405
Fertiliser NPK 1	0.155	6.446
Fertiliser NPK 1	0.983	1.017
Mechanisation	0.982	1.018

Table 6 shows the multicollinearity test results of this study. The variance inflation factor (VIF) is a statistical tool that may identify and quantify the level of collinearity present in a multiple regression model. Variance Inflation Factor (VIF) quantifies the extent to which the variance of the predicted regression coefficients is increased when the predictor variables are linearly connected. Multicollinearity arises when the variance inflation factor (VIF) exceeds 10 and the tolerance value falls below 0.1 (Hair et al., 2010). It means that there is no existence of multicollinearity problem among predictor variables.

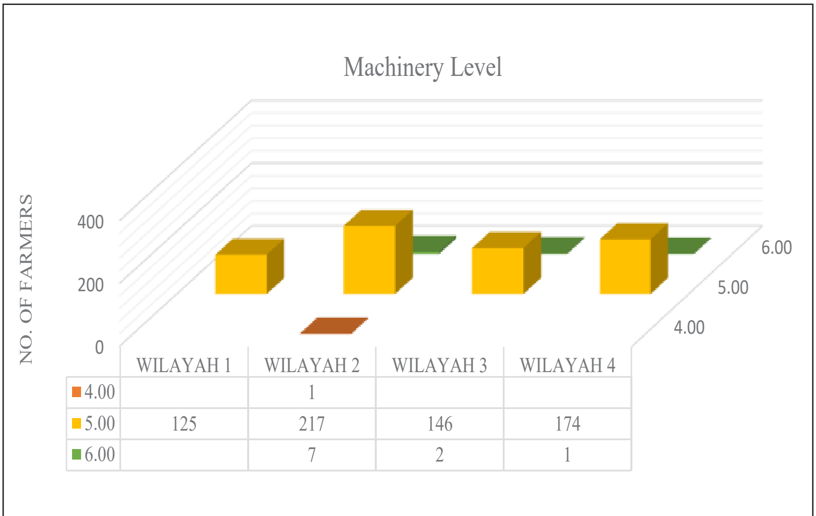
The Usage of Machinery and the Machinery Level among MADA Paddy Farmers

The paddy industry in Malaysia frequently uses machinery for all its operations, from clearing the land to harvesting the crop. Utilisation of mechanisation in paddy cultivation allows the farmer to complete the task more quickly and with greater field flexibility. It has many advantages, including raising productivity and yield per unit of land area, decreasing the number of labourers needed, lowering the cost of labour, units, and production, and bringing about advancements in agricultural technique (Pingali, 2007). The use of machinery in paddy cultivation eliminates the need for labour at many stages, which benefits the farmer economically by lowering cultivation costs (Chandran, 2018).

To examine the usage of machinery in paddy cultivation across the four MADA regions, seven major farmer activities involving machinery were analysed. The machinery activities examined were as follows: field preparation, sowing seeds, application of fertiliser, spraying pesticides, harvesting paddy, planting paddy, and drone usage. Figure 1 presents the machinery level of MADA paddy farmers in paddy cultivation. As can be seen from the Figure 1 below, the majority of the paddy farmers which was around 662 farmers, achieved level 5. Only one farmer achieved level 4 in Region 2. From the data in Figure 3, it is apparent that seven farmers from Region 2, two farmers from Region 3 and one farmer from Region 4 achieved level 6 out of 7 machinery levels.

Figure 3

Machinery Level across MADA Regions



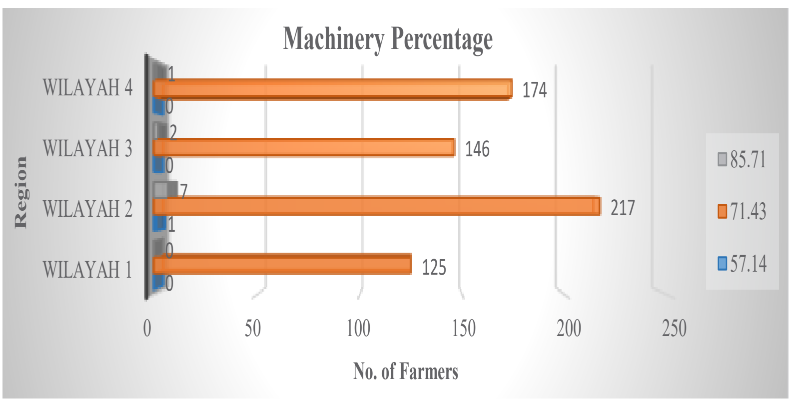
The Percentage of Machinery Use in MADA Regions

The percentage of MADA paddy farmers who use machinery in each of the four regions will be discussed in this section. The majority of respondents to in the study's questionnaire stated that they reached 71.43 percent machinery utilisation during the 2020 cropping season.

A total of 662 paddy farmers used machinery for paddy harvesting, pesticide application, seed sowing, fertiliser application, and land preparation. They used machinery for land preparation, sowing seeds, application of fertiliser, spraying pesticides, and harvesting paddy. It can be seen from Figure 4 below that all the farmers in Region 1 had achieved 71.43% in machine usage. A small number of those interviewed indicated that they had achieved a high of 85.71% usage of machinery. Interestingly, seven farmers from Region 2, two farmers from Region 3, and one farmer from Region 4 achieved the highest machinery percentage in the MADA regions. Only one farmer from Region 2 had a machinery use percentage that was lower than the others (57.14%).

Figure 4

Percentage of Machinery Usage across MADA Regions



CONCLUSIONS AND RECOMMENDATIONS

The Malaysian government has given high priority to the paddy sector because of its importance as a dependable agricultural crop for the country. The Malaysian government's objective is to attain a self-sufficiency rate of 75 percent by 2025 to meet the nation's rice requirements. However, the rice industry in Malaysia is presently encountering several obstacles, leading to a lack of optimal paddy output in most rice-growing regions. The primary objective of the present study was to investigate the effect of socioeconomic attributes of farmers, their perspectives on management practices, and the use of paddy machinery technology on paddy productivity in the four MADA regions.

The result revealed that land area, choosing paddy as the main occupation, spending more time on paddy farms, gender, and farmer education status effected paddy productivity in MADA regions. It is important to address these factors can improve productivity in MADA regions. In terms of machinery utilisation, the findings show that just a minority of farmers utilised machinery at the highest rate. Hence, it is recommended that management has to educate farmers on how to employ technology at every stage of rice farming. This effort will add to the current knowledge of paddy farmers on how to effectively utilise machines and technological inputs. Since this study did not include the latest automation used in paddy farming, so the future study may include this.

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