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IMPACT OF HIGH YIELDING VARIETIES ON PADDY PRODUCTION IN MUDA AGRICULTURAL DEVELOPMENT AUTHORITY AREAS, MALAYSIA

ABIOLA OLAPEJU ADEDJOYIN

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By

ABIOLA OLAPEJU ADEDOYIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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DEDICATION

This thesis is especially dedicated to my husband, Mr. Adeyemi Adeshola Samuel and my lovely child. At all times, worst and best, they stood by me. I really appreciate my husband so much, though not all husbands are ready to fulfil their responsibilities but you are such a rare gem for sponsoring me. His affection, prayers and encouragement most especially when I felt I was left with nothing in this world are really commendable.
IMPACT OF HIGH YIELDING VARIETIES ON PADDY PRODUCTION IN MUDA AGRICULTURAL DEVELOPMENT AUTHORITY AREAS, MALAYSIA

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ABIOLA OLAPEJU ADEDOYIN

April 2016

Chairman : Profesor Datuk Mad Nasir Shamsudin, PhD
Faculty : Agriculture

Worldwide, technological change in paddy production has given in an era of agricultural development and increased productivity performance. However, such performance appears to be unevenly distributed among farmers. Though, with new technologies introduced in Malaysia, development is premised on the recognition that low productivity is a major cause of the lack of advancement in the paddy sector. Hence, in order to ensure self-sufficiency in paddy production, the use of high-yielding varieties of paddy seed has been a strategic way for increasing paddy yields.

This study, therefore, investigated the impacts of high yielding varieties on paddy production in Muda Agricultural Development Authority, (MADA) Areas. Specifically, the study established whether the new high-yielding varieties have significant effects on paddy yield. The study also examined the magnitude of paddy production due to the shift from old to new HYVs of paddy seed. Furthermore, the study analyzed socio-economic factors influencing the adoption of new high yielding varieties as well as the optimum efficiency of resource used in paddy production.

The data were collected through a well-structured questionnaire. The study sampled 396 paddy farmers using multistage sampling technique. The independent samples t-tests, F-test, Cobb-Douglas production, Ordinary Least Square analysis technique and (binary) logit regression analysis were used to analyse the data. The estimated results of all the inputs used on per hectare had positive signs and conformed to a prior expectation. All the five inputs used, seed, fertilizer, labour, pesticides, and herbicides influence paddy yield in MADA, areas. The paddy farms were found to exhibit increasing return to scale. This shows that, the paddy farms have characteristics of stage one of production. It means that, if the farm increased all inputs by 1 per cent, production will give 1.07 per cent. This result obtained suggested that there is every possibility to increase paddy production by improving the use of those inputs.
The findings re-affirmed the claim that socio-economic factors such as education level, farming experience, gender, training and farm size were the factors influencing the adoption of new high yielding varieties in MADA, areas. Estimated results on the effect of high-yielding varieties indicated that the use of the new high yielding varieties had a positive significant effect on paddy yield at 1 per cent. The result revealed 42 per cent more on average paddy yield by giving 1.5 times more yield compared to old varieties. There exists an upward neutral shift in production function curve. More so, since the coefficient of dummy is positively significant with a much smaller standard error of 0.02, the intercept of new high-yielding varieties is known to be higher than the old varieties which signify a shift in production function.

Based on the estimated results on the optimum resource efficiency used in paddy production, it was revealed that all inputs employed, seed input, fertilizer application, pesticides, herbicide and labour inputs were under-utilized as their ratios were greater than unity. Therefore, maximum optimal resource achievement is possible by re-organizing input utilization allocation on paddy farms. The enhancement in the resource among the farmers is the work of the individual farmers, government and research institutions. It is therefore the responsibility of the extension agents to raise efficient and knowledge based paddy farmers through specific farm management training, which train the paddy farmers on the efficient use of available resources. This would help the farmers in allocating the inputs effectively. Extension agents in the study area as a whole also need to be improved on various ways used in disseminating new high yielding varieties to farmers. The strategies for paddy technology transfer to farmers should be specially packaged.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

IMPAK HASIL TINGGI KEPELBAGAIAN TERHADAP PENGELOUARAN PADI DI KAWASAN MUDA AGRICULTURAL DEVELOPMENT AUTHORITY, MALAYSIA

Oleh

ABIOLA, OLAPEJU ADEDOYIN

April 2016

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Di seluruh dunia, perubahan teknologi dalam pengeluaran beras telah berlaku dalam era pembangunan pertanian dan prestasi produktiviti meningkat. Bagaimanapun, prestasi itu nampaknya tidak sekata dalam kalangan petani. Walau bagaianamanapun, dengan teknologi baru diperkenalkan di Malaysia, pembangunan adalah berasaskan kepada pengiktirafan bahawa produktiviti yang rendah adalah punca utama kekurangan kemajuan dalam sektor padi. Oleh itu, dalam memastikan sara diri dalam pengeluaran beras, mencukupi penggunaan pelbagai jenis padi yang berhasil tinggi adalah kaedah strategik dalam meningkatkan pengeluaran padi. Oleh itu, kajian ini adalah untuk mengkaji kesan jenis hasil tinggi pada padi di kawasan Lembaga Kemajuan Pertanian Muda, kawasan. Khususnya, kajian ini ditubuhkan untuk mengetahui sama ada jenis yang berhasil tinggi baru mempunyai kesan yang besar ke atas hasil padi. La juga untuk mengkaji magnitud pengeluaran padi disebabkan oleh peralihan dari lama kepada HYVs baru benih padi. Tambahan pula, kajian ini menganalisis faktor sosio ekonomi yang mempengaruhi penggunaan jenis berhasil tinggi yang baru dan menganalisis sumber yang optimum digunakan dalam pengeluaran padi.

Data yang dikumpul adalah melalui soal selidik berstruktur. Kajian sampel adalah seramai 396 pesawah dengan menggunakan teknik persampelan berbilang. Sampel bebas Ujian-t, F-ujian, pengeluaran Cobb-Douglas, Square Ordinary Least analisis regresi dan (binari) logit telah digunakan untuk menganalisis data. Anggaran keputusan semua input yang digunakan pada setiap hektar mempunyai tanda-tanda positif dan serupa dengan jangkaan sebelumnya.

Kesemua lima input yang digunakan, benih, baja, buruh, racun perosak, dan racun herba mempengaruhi hasil padi di MADA, kawasan. Ladang padi didapati menunjukkan skala peningkatan pulangan. Hai ini menunjukkan bahawa, ladang padi
mempunyai ciri-ciri peringkat pertama pengeluaran. Hai ini bermakna jika ladang meningkat semua input dengan 1 peratus, pengeluaran akan memberikan 1.07 peratus. Keputusan yang diperolehi mencadangkan bahawa terdapat setiap kemungkinan untuk meningkatkan pengeluaran padi dengan meningkatkan penggunaan mereka input.

Hasil kajian mengesahkan bahawa faktor-faktor sosio-ekonomi seperti tahap pendidikan, pengalaman pertanian, jantina, latihan dan saiz ladang adalah faktor yang boleh mempengaruhi pelbagai berhasil tinggi baru di MADA, kawasan. Anggaran hasil terhadap kesan jenis berhasil tinggi menunjukkan bahawa penggunaan satu jenis variasi berhasil tinggi yang baru telah memberi kesan positif kepada hasil padi pada 1 peratus. Keputusan menunjukkan 42 peratus lebih pada hasil padi purata dengan lebih hasil 1.5 kali tua jenis. Terdapat peningkatan dalam fungsi pengeluaran. Oleh kerana, pekali dummy adalah positif dengan ralat yang lebih kecil piawai 0.02, dari memintas HYV adalah diketahui lebih tinggi daripada varisi tua yang menunjukkan perubahan dalam fungsi pengeluaran.

Berdasarkan keputusan anggaran yang dibuat kecekapan sumber optimun yang digunakan dalam pengeluaran padi, hal ini telah mendedahkan bahawa semua input seperti benih, baja, racun perosak, racun herba dan buruh adalah kurang digunakan kerana nisbah mereka adalah lebih besar daripada perpaduan. Oleh itu, pencapaian sumber optimum maksimum adalah mungkin dengan menganjurkan semula peruntukan penggunaan input di ladang padi. Peningkatan sumber dalam kalangan petani adalah tanggungjawab institusi petani kerajaan dan penyelidik individu. Oleh itu, adalah menjadi tanggungjawab ejen pengembangan untuk meningkatkan kecekapan dan pengetahuan berasaskan padi petani melalui pendidikan pengurusan ladang tertentu, yang melatih petani menjadi cekap untuk menggunakan sumber yang ada. Ini akan membantu petani memperuntukkan input secara berkesan. Ejen pengembangan di kawasan kajian sebagai satu keperluan keseluruhan untuk menambah baik dan membantu menyebarkan baik hasil yang tinggi varieti kepada petani. Strategi-strategi bagi pemindahan teknologi padi kepada petani perlu disusun atur khas untuk mereka.
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Except the lord build the house, he that buildeth it labour in vain (Isaiah 60:1). All thanks to Almighty God for granting me life in his favour and courage to reach this level of my life.

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ABIOLA OLAPEJU ADEDOYIN
I certify that a Thesis Examination Committee has met on 15 April 2016 to conduct the final examination of Abiola Olapeju Adedoyin on her thesis entitled "Impact of High-Yielding Varieties on Paddy Production in Muda Agricultural Development Authority Areas, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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CHAPTER 1

INTRODUCTION

Among the hierarchy of food crops in Malaysia, paddy is probably the most important and paddy self-sufficiency is a prerequisite for food security (Zainal, 2012). However, all attempt made to attain self-sufficiency in paddy production despite the use of new technologies and optimum input used still premised on the recognition that low productivity is the major cause of lack of advancement in the sector. This might be due to the fact that Malaysia paddy production is characterized by low yield per hectare, a multitude of small scale farmers of 2 hectares per farm land, weedy rice infestation, old working age factor in the field, low capitalization, poor technology adoption and excessive use of input. (Tawang et al., 2002; Angin, 2004; Wong et al., 2010; Zainal, 2012; Dos, 2013; Lira et al., 2014).

There was no significant advancement in yield as the mean yield is at 3.9 tons per hectare while the actual paddy farm yields varies from 3-5 tons per hectare below the neighbouring countries such as Vietnam and Indonesian at 5.5 tons per hectare and 4.9 tons per hectare respectively (Dos, 2013). The shifting from transplanting to direct seeding technology of planting of paddy have been reported to increased weedy paddy infestations resulting to crop loss per year at RM 180 million (Angin, 2004).

Even with the vital use of paddy crop in the country, the increase in paddy production threatened by farm size expansion is quite challenging. The overall number of paddy farm size is not more than 0.7millions hectares with average growth of about 0.27 per cent per year for the last two decades (Wong et al., 2010). Majority of the paddy farmers’ were cultivating on a small farm size ranging from 2.2 to 4 hectares (Normiyah et al., 1997). Presently, constraints of suitable soil fertility, competition with industrial, housing and domestic needs have been major factors threatening land expansion in Malaysia. Furthermore, paddy farm has been characterized to be inefficient as a result of old age factor working in the field. Majority of the farmers were above 60 years of age (Chan et al., 2012).

Excessive use of inputs such as chemical fertilizers and pesticides, above a given recommendations has caused a lot of problems in padding farming. This has caused soil degradation, water pollution and an increased number of pests, which are resistant to the application of pesticides. The level of financial constraint of farmer’s in using sophisticated machinery that can help in boosting paddy yield is worsened. All these occurrences have negative effects that threaten the level of productivity, technology transfer process and cannot in any way guarantee self-sufficiency in paddy production. Thus, in order to correct those problems, this study was carried out to determine the impact of HYVs on paddy production, to examine the socio-economic factors influencing the adoption of new high yielding varieties and to analyze the optimum resource efficiency used in paddy production as raising paddy production has been identified as very crucial as reflected in the new Malaysian economic transformation
1.1 Paddy Production in Malaysia

Malaysia is one of the highest 25 paddy producing countries in the world with annual production of 2.51 million metric tons (FAOSTAT, 2009). The annual consumption of paddy in the country was estimated to be 2.69 million tons which was only able to meet 68.5 per cent of production (Dos, 2013). The total population of 28.96 million Malaysian people were estimated in the country and only 296,000 were found to be total paddy growers (Zainal, 2012). The paddy industry in Malaysia has played an important role in agricultural diversification. Currently, paddy was position as the most essential food crop for ensuring the nation’s food security. In Malaysian economy, the industries have improved the social-economic and political importance such as poverty eradication and ever since then farmer’s livelihood have changed and are better-off.

Paddy is growned in eight granary areas of Peninsular Malaysia covering an area of 209,300 hectare (Azmi and Mashhor, 1995). The total area of paddy production as at year 2006 was about 645 hectare (USDA, 2008). The two main paddy producing areas in the country were Muda Agriculture Development Authority (MADA) and Kemubu Agriculture Development Authority (KADA). There are wet paddy areas having 85 per cent of the total paddy field and remaining 15 per cent were made up of hill paddy areas. Irrigated paddy field constituting of 321,696 hectare and out of these irrigated paddy fields were approximately 217,053 hectare to granary areas and 28,441 hectare was in non-granary areas which were divided as mini granary areas or secondary. The four main paddy areas in Malaysia are classified as irrigated, rain-fed, lowland and upland. Irrigated and lowland farming environments predominate in Peninsular Malaysia while rain-fed and upland farms are more common in Sabah and Sarawak.

1.1.1 Technology in Malaysia Paddy Production

The recent achievements in the ‘green revolution’ was the advancement of paddy farming technologies in Peninsular Malaysia as the country depends on 70 per cent local consumption while 30 per cent of paddy were been imported from neighbouring countries annually (Akinbile, 2001). The country in 1970’s was comparatively progressed in paddy sector among the Southeast Asian countries through the introduction of modern technologies. Among the new technologies introduced in Malaysia paddy production were HYVs of seeds, irrigation systems, chemical fertilizers, improved agronomic practices, pesticides, herbicides, labour-saving technologies such as farm mechanization and capital-intensive technology that includes the use of tractors, ploughs, weeders, broadcaster, transplanter, row seeder, point seeder and combine harvester’s over traditional way of paddy production. (Suswanto et al., 2007; Zainal, 2012; Chan et al., 2012 and Raudah et al., 2014)

Ever since then, agricultural sectors have turn into a better situation, though not sufficient for paddy production in the country. In 1970’s, there were 131,700 hectares of paddy land in Peninsular Malaysia, which were improved through irrigation
facilities, of which 110,563 were given in double-cropping areas. The government committed and execute the development projects both for water resources and infrastructures (irrigation and drainage) in a way to encourage paddy double cropping. Irrigation facilities were built in the paddy bowl areas in order to boost paddy production as its production largely depends on availability of water. The provision of adequate irrigation and drainage facilities in the eight granary areas had encourage paddy double cropping which enabled the achievement of a mean cropping intensity of more than 180 per cent in the areas. Paddy areas in Malaysia supplied with good irrigation and drainage system were located at:

1. Muda Agricultural Development Authority (MADA),
2. Kemubu Agricultural Development Authority (KADA), and
3. Integrated Agricultural Development Projects (IADPs) in six areas – Barat Laut (Selangor state), Seberang (Perak state), Pulau Pinang, Kerian-Sungai Manik, Kemasin-Semerak, and Trengganu Utara (KETARA).

More so, farm mechanization has gain popularity but not all farmers have full access to all these machines as a result of financial constraints. Basically, there is no domestic agricultural engineering industry. Malaysia relied mostly on imported agricultural machinery from Europe, especially Germany. The industry is confined to testing and adoption of imported machinery. Although, several measures have been introduced by the government to motivate personal ownership of small and medium machinery. Such measures are tax exemption by enjoying 100 per cent on imported machineries, government grants to farmers’ organization without interest and matching agents to assist farmers acquire small and medium farm machinery.

Table 1.1. Machinery Ownership Status (2012)

<table>
<thead>
<tr>
<th>No</th>
<th>Type of machinery</th>
<th>Government agency/PPT Units</th>
<th>%</th>
<th>Public Sector Units</th>
<th>%</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 wheeled tractor</td>
<td>249</td>
<td>7.78</td>
<td>2951</td>
<td>92.22</td>
<td>3200</td>
</tr>
<tr>
<td>2</td>
<td>Combined harvester</td>
<td>92</td>
<td>7.31</td>
<td>1166</td>
<td>92.69</td>
<td>1258</td>
</tr>
<tr>
<td>3</td>
<td>2 Wheeled tractor</td>
<td>0</td>
<td>0</td>
<td>7000</td>
<td>100</td>
<td>7000</td>
</tr>
</tbody>
</table>


The use of farm chemicals has increased tremendously over the years. Pesticides as one of the green revolution have make pests becoming resistant to chemicals as farmer’s used it above the recommended rate. The farmer’s had to try different combinations of chemicals to curb the problem but still persisted. Though, the use of varieties of seed that are resistant to pest and diseases are now in use to reduce the infestations (Zainal, 2012). New fertilizers as one of the technology revolution, have been made available for the paddy farmer’s in a subsidized rate. The subsidy was only giving to paddy farmer’s
with 10 hectares and below. All registered paddy farmer’s were supplied with 240 kg ha⁻¹ mixed fertilizer, 80 kg ha⁻¹ for organic fertilizer and 75 kg ha⁻¹ as well as RM 200/ha/season subsidy for pesticides control and additional fertilizer at RM 140/ha/season (Vengedasalam et al., 2011).

<table>
<thead>
<tr>
<th>Number</th>
<th>Incentives</th>
<th>Fertilizer type</th>
<th>Bag</th>
<th>Price (RM/bag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fertilizer subsidy scheme</td>
<td>Compound</td>
<td>12(20kg/bag)</td>
<td>RM29.97/bag</td>
</tr>
<tr>
<td>2</td>
<td>Food security incentives</td>
<td>Urea</td>
<td>4(20kg/bag)</td>
<td>RM25.75/bag</td>
</tr>
<tr>
<td>2</td>
<td>Food security incentives</td>
<td>NPK</td>
<td>3(25kg/bag)</td>
<td>RM89/bag</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture and Agro-Based Industry (2009).

### 1.1.2 Development of Paddy Varieties in Malaysia

The termed ‘Green Revolution’ is known to be a technology transformation which has been based on high-yielding varieties in increasing cereals crop yields since 1960’s (Dana, 1978). Though, fertilizer and irrigation helped raise cereals yields but their impact was fully revealed after the release of high-yielding varieties.

Majorly, the importance of introducing new paddy varieties in Malaysia is to improve the country’s paddy production as the major staple food and to increase the level of productivity as land is becoming challenging. Introduction of high-yielding varieties is one of the steps initiated for agricultural development in Malaysia paddy production. HYVs breeding technology is considered as a revolutionary change from the age-old tradition to contemporary innovation in the practice of agriculture. Under the green revolution technology, HYVs are the major input of agricultural production. The introduction was in the late 1960s and has tripled Asian paddy production from 200 million tons in 1960 to more than 600 million tons in 2010 with the help of irrigation and subsidized inputs such as pesticides and fertilizer (Ricepedia, 2013). Its adoption level in Asia was only about 40 per cent total cereals area in 1980’s and increased to about 80 per cent of the cropped area in year 2000 (Ricepedia, 2013).

The first high-yielding varieties named IRRI-8 was released in 1966 while other ten varieties were developed in 1975 (Dana, 1978; Ricepedia, 2013). Though, more generation varieties with high-yielding potentials and resistance to pest and diseases have been developed due to the fact that the seed variety produced are susceptible to pest and diseases. These varieties are characterized to have a shorter maturity days, good grain quality, higher yield potentials, resistance to pest and diseases, improve lodging resistance and tolerance to soil problems. It helps particularly to use the land for double cropping and multiple cropping resulting in high productivity and its land saves. The seeds are developed to get higher yielding and better quality yielding compared to the yield of traditional seeds. It is a type of seed that gives higher yield under irrigated conditions and the crop should be irrigated at the right time of schedule.
time. The use of high-yielding varieties of rice have reported to increase the average yield in last 25-50 years of irrigated rice from 2-3 to 5-6 ton per hectare and minimized crop period from about 140 days to 110 days (Bouman and Tuong, 2001).

Earlier in Malaysia, varieties under these categories are; IR 8, MR 71, MR 232, MR 219, and MR 220. Among these HYVs, only MR 219 and MR 220 has been the most common varieties planted by Malaysian paddy farmers’ in more than 90 per cent granary areas (Suswanto et al., 2007; Raudah et al, 2014). It has been used by farmers for 12 years and has contributed significantly to increase production and food security requirements (MARDI, 2011). However, in recent time, the performance of both varieties decreased due to prevalence of weedy, pest and diseases infestations in the granary areas. To avoid the loss of farmers’ MR 220CL1, MR 220CL2, MR 263 and MR 269 was launched as an alternative use to MR 219 and MR 220 because how can high yield be obtained when paddy seed is been faced with weedy, pest and diseases.

MR 220CL1 and MR 220CL2 was developed by Malaysia Agriculture Research and Development Institute (MARDI) to solve the problem of wild and weedy paddy infestations which approximately 10 per cent of granaries areas are facing. It is a breed of paddy that can withstand pest and diseases like weedy paddy. Both Varieties were developed by breeding local varieties, MR 220 and MR 219 with an American paddy variety. The other new varieties MR 263 and MR 269 were also released by MARDI with varieties that have a tolerant level of panicle blast, sheat blight, and moderate resistance level with Tungro, brownplant hopper and leaf blast. It is a variety against pest and diseases. The utilization of all these new varieties have not been widely used by all farmers, though used by some of the farmers’ in granaries areas instead the old varieties MR 219 and MR 220 were still in vogue. Majorly, there are eight varieties of paddy growned in Malaysia, MR 220, MR 219, MR 263, MR 230, MR 185, MR 211, MR 220CL1 and MR 220CL2 with maturity days ranging between 105 and 120 days. In Peninsular Malaysia, thirty eight (38) paddy varieties with their yields have been recorded thus far by MARDI till date as listed in Table 1.3 and 1.4 below.
### Table 1.3. Lists of Released Paddy Seed Varieties in Malaysia (1974-2013)

<table>
<thead>
<tr>
<th>Names</th>
<th>Year Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.MALAYSIA 1</td>
<td>1974</td>
</tr>
<tr>
<td>S.MALAYSIA 2</td>
<td>1974</td>
</tr>
<tr>
<td>P.MALAYSIA 1</td>
<td>1979</td>
</tr>
<tr>
<td>SETANJUNG</td>
<td>1979</td>
</tr>
<tr>
<td>SEKEN CANG</td>
<td>1979</td>
</tr>
<tr>
<td>SEKEM BANG</td>
<td>1981</td>
</tr>
<tr>
<td>KADARIA</td>
<td>1981</td>
</tr>
<tr>
<td>P.SIDING</td>
<td>1981</td>
</tr>
<tr>
<td>MANIK</td>
<td>1984</td>
</tr>
<tr>
<td>MUDA</td>
<td>1984</td>
</tr>
<tr>
<td>SEBERANG</td>
<td>1984</td>
</tr>
<tr>
<td>MAKMUR</td>
<td>1985</td>
</tr>
<tr>
<td>MR 84</td>
<td>1986</td>
</tr>
<tr>
<td>MR 81</td>
<td>1988</td>
</tr>
<tr>
<td>MR 103</td>
<td>1990</td>
</tr>
<tr>
<td>MR 106</td>
<td>1990</td>
</tr>
<tr>
<td>P.HITAM 9</td>
<td>1990</td>
</tr>
<tr>
<td>MR 123</td>
<td>1991</td>
</tr>
<tr>
<td>MR 127</td>
<td>1991</td>
</tr>
<tr>
<td>MR 159</td>
<td>1995</td>
</tr>
<tr>
<td>MR 167</td>
<td>1995</td>
</tr>
<tr>
<td>MR 185</td>
<td>1997</td>
</tr>
<tr>
<td>MR 211</td>
<td>1999</td>
</tr>
<tr>
<td>MRQ 50</td>
<td>1999</td>
</tr>
<tr>
<td>MR 219</td>
<td>2001</td>
</tr>
<tr>
<td>MR 220</td>
<td>2003</td>
</tr>
<tr>
<td>MRQ 74</td>
<td>2005</td>
</tr>
<tr>
<td>MR 232</td>
<td>2006</td>
</tr>
<tr>
<td>MR 220CL1</td>
<td>2010</td>
</tr>
<tr>
<td>MR 220CL2</td>
<td>2010</td>
</tr>
<tr>
<td>MR 253</td>
<td>2011</td>
</tr>
<tr>
<td>MR 263</td>
<td>2011</td>
</tr>
<tr>
<td>MRQ 76</td>
<td>2012</td>
</tr>
<tr>
<td>MR 269</td>
<td>2012</td>
</tr>
<tr>
<td>MRIA</td>
<td>2013</td>
</tr>
</tbody>
</table>

Source: Zainal (2012)

Potential yield of Malaysian paddy varieties is presented in the Table 1.4 below.
Table 1.4 Malaysian Paddy Seed Varieties (1973-2010)

<table>
<thead>
<tr>
<th>Names</th>
<th>Yield (kg/hectare)</th>
<th>Year Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAYA</td>
<td>3500-5000</td>
<td>1973</td>
</tr>
<tr>
<td>MR1 (SETANJUNG)</td>
<td>4100-6000</td>
<td>1979</td>
</tr>
<tr>
<td>KADARIA</td>
<td>2900-5000</td>
<td>1981</td>
</tr>
<tr>
<td>MR 52 (Manik)</td>
<td>4000-5000</td>
<td>1984</td>
</tr>
<tr>
<td>MR 71(MUDA)</td>
<td>5000-5500</td>
<td>1984</td>
</tr>
<tr>
<td>MR 77(SEBERANG)</td>
<td>5000-5500</td>
<td>1984</td>
</tr>
<tr>
<td>MR 73(MAKMUR)</td>
<td>5500-6500</td>
<td>1985</td>
</tr>
<tr>
<td>MR 84</td>
<td>4057-6235</td>
<td>1986</td>
</tr>
<tr>
<td>MR 81</td>
<td>4200-6000</td>
<td>1989</td>
</tr>
<tr>
<td>MR 106</td>
<td>4500-7100</td>
<td>1990</td>
</tr>
<tr>
<td>PH 9 (PULUT HITAM)</td>
<td>3800-4700</td>
<td>1990</td>
</tr>
<tr>
<td>MR 127</td>
<td>4831-7245</td>
<td>1991</td>
</tr>
<tr>
<td>MR 159</td>
<td>3500-5400</td>
<td>1995</td>
</tr>
<tr>
<td>MR 167</td>
<td>4000-6000</td>
<td>1995</td>
</tr>
<tr>
<td>MR 211</td>
<td>6000-9000</td>
<td>1999</td>
</tr>
<tr>
<td>MRQ 50</td>
<td>3500-4500</td>
<td>1999</td>
</tr>
<tr>
<td>MR 219</td>
<td>7000-10000</td>
<td>2001</td>
</tr>
<tr>
<td>MR 220</td>
<td>7000-10000</td>
<td>2003</td>
</tr>
<tr>
<td>MRQ 74 (MASWANGI)</td>
<td>4500-5500</td>
<td>2005</td>
</tr>
<tr>
<td>MR 232</td>
<td>7000-10000</td>
<td>2006</td>
</tr>
<tr>
<td>MR 220 CL1</td>
<td>5740-9140</td>
<td>2009</td>
</tr>
<tr>
<td>MR 220 CL2</td>
<td>5840-9740</td>
<td>2009</td>
</tr>
<tr>
<td>MR 253</td>
<td>5600-7000</td>
<td>2010</td>
</tr>
<tr>
<td>MR 263</td>
<td>5500-7000</td>
<td>2010</td>
</tr>
</tbody>
</table>

Source: Salmah, (2014)

1.2. Paddy Production in MADA

MADA (Muda Agricultural Development Authority) is an established area in Malaysia in order to boost paddy production. It is located along the coastal plain in the northern states of Kedah and Perlis in the peninsular Malaysia (Loh, 2011). There are four regions in MADA, namely Kangar region, Jitra region, Pendang region and Kota Sarang Semut region with population size of 45,800 paddy farmer’s in the regions.

The total area was estimated to be 126,155 hectares with total paddy area of 96,558 hectares, of which 80.66 per cent is located in the State of Kedah and 19.34 per cent located in the state of Perlis and about 40 per cent of national paddy production is being produced from the area (MADA, 2010; MADA, 2012). There are 40,000 hectares of paddy area of non-irrigated areas located outside the Muda Agricultural
Development Authority (MADA) and the Integrated Agricultural Development Project (IADPs). Farmers, who own less than one hectare, cultivate paddy once in every season, with production of 3 tons per hectare (Fauzi, 2013). There were about 55,130 paddy farmers in the area with an average size of 2.2 hectares with the sole-ownership status of land or rent. About 47 per cent of the farm families are owner-operators, 25 per cent are tenants, 17 per cent are owner-tenants, and 9 per cent are others each managing a farm.

It is a drought prone area with major water supply from 4 major sources. The sources are from direct rainfall on paddy fields, dam release, uncontrolled river flow and recycled drainage water. Despite the good irrigation infrastructure facilities, nearly 52 per cent of the total water supplies for paddy production are still from rainfall. The reservoirs (and dams) provide about 30 per cent, followed by rivers (13 per cent) and recycled water (5 per cent). This actual annual water supply from rain, uncontrolled flow and dam release is reported to be between 2.9m and 4.1m high and equal to at least 3,000 million cubic meters for the entire area (Tawang & Ahmad, 2003).

The low income areas among the granary areas were estimated to be MADA in the country. The per capita income is only about two-thirds of that of the national income. As an agricultural area, most of the low income population groups are directly related with economic activities in the agricultural sector. The average income for farmers was of RM1, 806 monthly, of which RM1, 267 per month comes from paddy cultivation. The average monthly expenses were RM1, 575 per month indicating that the income for paddy cultivation was unable to cover farmer monthly expenses (Mohd, 2013).

Most of the paddy farmers work on rented paddy fields or leased from other owners. A total of 78 per cent work full time as paddy cultivators, with 56 per cent of farmers’ have been in this field for more than 11 years. Almost all farmers’ get subsidized fertilizer and pesticides from the government but not many farmers’ receive assistance in terms of machinery (Fauzi, 2013).

MADA contributes more to national paddy production with an average yield of 5 tons per ha per season, higher than the national average of 3.74 (MADA, 2010). Table 1.5 shows the contribution of paddy in MADA to national paddy production as at year 2010.
Table 1.5 MADA Contributions to National Rice Production (2010)

<table>
<thead>
<tr>
<th>Granary Area</th>
<th>Area (HA)</th>
<th>% Area</th>
<th>Contribution To National Production (Metric Tonne)</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2010%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MADA</td>
<td>96,558</td>
<td>23.22</td>
<td>887,992</td>
<td>37.74</td>
<td>976,192</td>
<td>38.88</td>
<td>912,321</td>
</tr>
<tr>
<td>KADA</td>
<td>32,167</td>
<td>7.74</td>
<td>179,048</td>
<td>7.61</td>
<td>209,950</td>
<td>8.36</td>
<td>201,135</td>
</tr>
<tr>
<td>IADAK.S.MANIK</td>
<td>27,829</td>
<td>6.69</td>
<td>169,753</td>
<td>7.21</td>
<td>187,117</td>
<td>7.45</td>
<td>184,563</td>
</tr>
<tr>
<td>IADA BLS&quot;GOR</td>
<td>18,814</td>
<td>4.52</td>
<td>174,247</td>
<td>7.41</td>
<td>202,633</td>
<td>8.07</td>
<td>210,292</td>
</tr>
<tr>
<td>IADA P.PINANG</td>
<td>10,305</td>
<td>2.48</td>
<td>98,436</td>
<td>4.18</td>
<td>107,285</td>
<td>4.27</td>
<td>115,189</td>
</tr>
<tr>
<td>IADASBG PERAK</td>
<td>8,529</td>
<td>2.05</td>
<td>62,076</td>
<td>2.64</td>
<td>70,294</td>
<td>2.80</td>
<td>70,814</td>
</tr>
<tr>
<td>IADA KETARA</td>
<td>5,156</td>
<td>1.24</td>
<td>46,097</td>
<td>1.96</td>
<td>49,082</td>
<td>1.95</td>
<td>52,711</td>
</tr>
<tr>
<td>IADA</td>
<td>5,220</td>
<td>1.26</td>
<td>14,757</td>
<td>0.63</td>
<td>16,853</td>
<td>0.67</td>
<td>20,550</td>
</tr>
<tr>
<td>K.SEMERAK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL GRANARY</td>
<td>204,578</td>
<td>49.20</td>
<td>1,632,406</td>
<td>69.38</td>
<td>1,819,206</td>
<td>72.46</td>
<td>1,757,575</td>
</tr>
<tr>
<td>TOTAL NON-GRANARY</td>
<td>211,213</td>
<td>50.80</td>
<td>720,626</td>
<td>30.63</td>
<td>691,637</td>
<td>27.54</td>
<td>707,256</td>
</tr>
</tbody>
</table>

Source: Early Reports Paddy Production Survey Study off Season 2010 Issue of Secretariat National Survey of Rice Production, Department of Agriculture, Accountants. ^ Preliminary Data

Although it is the largest granary area, it lacks large industrial-scale growers, small-scale farmers’ with average farm size of 2 hectares and most of the production is by traditional methods. Majority of the paddy farmers’ in MADA were old with an average age of 60 years & above (MARDI, 1984; Normiyah & Chang, 1997).

Table 1.6 Farmers Age Pattern in MADA Areas (2012)

<table>
<thead>
<tr>
<th>Age of Farmers</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 35</td>
<td>1.9</td>
</tr>
<tr>
<td>35.1-45</td>
<td>7.3</td>
</tr>
<tr>
<td>45.1-55</td>
<td>24.8</td>
</tr>
<tr>
<td>55.1-65</td>
<td>38.2</td>
</tr>
<tr>
<td>&gt;65</td>
<td>27.8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Chan et al. (2012)

Farmers attained low level of education as two-thirds of the paddy farmers had a primary education, 16 per cent are found to have completed their secondary school, 8 per cent attended religious school while 12 per cent were found not to have any basic education (Normiyah et al; 1995).
Methods of paddy planting in MADA have changed from transplanting to direct seeding methods due to the drudgery involved in transplanting. Absence of labour and increase wage rate makes the majority of paddy farmers’ changed to direct seeding system. Direct seeding is a method of planting crops directly into soil and it’s of three types namely direct wet seeding, direct dry seeding and direct seeding in water. The common traditional practice for paddy cultivation is wet direct seeding, though mechanized transplanting is fast gaining popularity. The three methods of direct seeding are:

1. Direct Wet Seeding

A method where by paddy straw stubble is cut, disperse, leave for 2-5 days to be dry and it must be totally burn in order to destroy the weedy paddy seed. This is usually done followed by the first dry rotation after 7-14 days of burning straws while the second wet rotation is done when the soil is overrun by water. After which, pretilachlor is applied to the stagnant water (height between 5-10 cm) and leave it for 10 days. Then, the paddy seed is scattered when the soil is flattened and in damp condition.

2. Direct Dry Seeding

Direct dry seeding normally uses less water as compared to wet direct seeding. Direct dry seeding uses 5-10 per cent less water, whereas seeding in standing water uses 10 per cent less water as compared to wet direct seeding. Direct dry seeding paddy is a type of planting methods that has the potential in reducing water and labour use compared with farmers conventional transplanting giving an average of 67-104m of saving irrigation water in direct seeding paddy compared with transplanted paddy (Tabbal et al., 2002). Mostly, dry soil rotation is done in the first paddy-planting season, which is usually done in dry way. After the dry rotation, the soil is flattened with cam tractor and sowing on the dry surface of the paddy field follows this. Another rotation is done to mix the seed with the soil.

3. Direct Seeding in Water

This type of method follows the same way of direct wet seeding but glisofat or glufosinat weedicide application is added to subdue weed growth especially weedy paddy after the first rotation. This is followed by the second rotation (wet rotation), after which pretilachlor poison is applied to stagnant water (5-10 cm) for 10 days. Sowing is done in water logging paddy field; this is to reduce the infestation of weedy paddy. Other than direct seeding, planting method could also be used. This traditional planting method by hand is no longer in use but the jentanam method. This method might increase the planting time and also determine the consistent paddy seed numbers that have been planted. In addition, this method would be able to facilitate the pest control and disease that occur in the paddy field. Direct seeding method can either be done through broadcasting conventionally or in a mechanized way. This method can be highly mechanized to reduce labour-intensive planting and then transplanting seedlings by hand. Although there are seedling transplanting machines
available, they are very expensive and thus not that widely used in many countries. The machines are very labor efficient but are not feasible to buy for many farmers since the price is so expensive. Most farmers rent the machines from other farmers, but the cost of renting can still be expensive since the farmers must pay for transportation of the machine as well as the human labor for use.

### 1.3 Problem Statement

Following the phenomenal success of the green revolution technologies, which were first initiated in Mexico in the 1940s, Malaysian government introduced these new technologies for paddy cultivation in MADA with the aim of increasing production. However, this aim was not attained due to poor technological adoption. High yielding varieties of paddy seed have been in existence in Asia and in Malaysia, in particular, since 1966. These varieties have a resistance to pest and diseases, tolerance to soil problems and higher yield potential, which can add to the improvement of the farmers income, agricultural growth, and economic development of rural communities. Extension workers and individual farmers have a role to play in bringing change in adoption of new high yielding varieties technology. However, due to the old age of working factor of farmers in the field, low education attained by the paddy farmers, low exposure of farmers to specific training programmes, small farm size and inadequate of effective farmers leaders to facilitate the dissemination of agricultural information to the farmers hindered the adoption level of the new high yielding varieties in the study area.

The level of education acquired by a farmer to a large extend determines the farmer’s adoption level of new technology without stress. It’s is expected that farmer’s with high level of education will adopt new innovations on their farms and used it effectively to increase productivity, income and subsequently the profit obtain by the farmers. Nevertheless, paddy farmers in MADA attained low level of education as majority had primary education level while minority had proceeded to university. This makes it less easily for the paddy farmers to adopt the new high yielding varieties.

Outmigration of young farmers is a serious problem among paddy farmers in the study area. Presently, majority of the paddy farmers in the study area were above 70 years of age. Farmers were classified as less active and unproductive due to old age working factor in the field. This makes the farmers less prone to changes and reluctant to adopt the new high yielding varieties due to risk and uncertainty which hindered technology transfer process and threaten the productivity level.

Leaders form a link connecting farmer’s and extension agents. They disseminate educational information and try to modify farmers perspective. Leadership has significant role in agricultural extension, as it deals with educating groups of farmer’s in the community. Yet, leaders in MADA are running into a few trials. One such problem is in the adoption of new high yielding varieties. The proportion of paddy farmer’s that are exposed to paddy cultivation training were far below farmers that do not attend any training on paddy production as a result of the absence of training made available by agencies to leaders and the absence of expertise. Hence, they often fail to
transfer what they learn about new high yielding varieties to other farmers because of poor communication between the leaders’ and farmer’s and these will not facilitates the adoption of the new high yielding varieties as more training programmes brings about high adoption of technology.

Production threatening by land expansion is really threatening. MADA is lacking large, industrial growers as majority were cultivating on farm size of 2 hectares. The overall number of paddy area is not more than 0.7millions hectares with average growth of about 0.27 per cent per year for the last two decades. Though, constraints of suitable soil fertility, competition with industrial, housing and domestic needs have been major factors threatening land expansion in the study area.

Moreover, the current level of actual farm paddy yield is considered far below the potential yield as well as attainable yield that should be achieved by the paddy farmers. There was no significant improvement in production despite the adoption of chemical fertilizers, irrigation system and improved agronomic practises. The average paddy yield is still at 3.9 tons per hectare while the actual paddy farm yields vary from 3-5 tons per hectare below that of neighbouring countries such as Vietnam and Indonesian at 5.5 and 4.9 tons per hectare respectively.

There are no regulated standard procedures on farm machinery shifting thereby causing spreading of paddy plant diseases and paddy weed as transferring of field machineries and equipment from one area to another without control and preventive measures resulted in spread of diseases. Moreover, shifting from transplanting to direct seeding technology of cultivating paddy due to the drudgery involved in paddy cultivation has caused a high prevalence of weedy paddy infestations resulting to crop loss per year at RM 180 million. Due to these problem, excessive use of inputs such as chemical fertilizers and pesticides, above a given recommendations were been used by the farmers’ to curb the infestations. This has caused soil degradation, water and air pollution and has increased numbers of pest that are resistance to application of pesticides.

All these circumstances cannot in any way guarantee self-sufficiency in paddy production. Thus, to correct these problems, the use of HYVs of paddy seed have been a strategic way of increasing paddy production as raising paddy production has being identified as very crucial as reflected in the new Malaysian economic transformation programme.

1.4 Research Questions

The issues aforementioned in this study’s problem statement warrant the following questions:

1. What are the socio-economic factors influencing the adoption of the new high yielding varieties of paddy seed?
2. Does a new high yielding variety have a significant impact on paddy yield?
3. Are resources optimally utilized in paddy production?

1.5 Objectives of the Study

The general objective of the study is to assess the impacts of high yielding varieties on paddy production in MADA. To achieve this, the specific objectives outlined for this study are;

1. To examine the socio-economic factors influencing the adoption of new high yielding varieties;
2. To determine the effect of new high-yielding varieties on paddy yield;
3. To analyse the optimum efficiency of resource used in paddy production.

1.6 Hypothesis

The following hypotheses are postulated for testing:

Ho: There is no significant effect of new HYVs on Paddy yield;
Ha: There is a significant effect of new HYVs on paddy yield.
Ho: There is no significance difference between the regression models;
Ha: There is significant difference between the two regression models.

1.7 Significance of the Study

Countries that have experience growth in agricultural productivity to a higher level used improved agricultural inputs. As Malaysia’s paddy production pattern, which is currently faced with infestation of weedy, pests and diseases, smallholders and difficulties in land expansion, giving a threat to productivity level, the strategic way to boost paddy production is to focus on adoption of technology that can in turn increase paddy yield in order to meet self-sufficiency at 100 per cent in respective of shortage in land use. This paper aims to contribute in two ways; theoretically the study added to existing body of literature by providing a micro perspective on the effect of agricultural technology in increasing crop production. Practically, the study provides feedback in guiding government policy makers, researchers, extension agents and those involved in technology transfer to have a better understanding on how technology adoption help in increasing crop production.

1.8 Scope of the Study

The study was carried out in MADA (state of Kedah and Perlis). The research was limited to paddy-based farmer’s in MADA, Malaysia. The choice of the study area for this research was due to the fact that the state of MADA has the largest paddy farming area among other state in Malaysia. It is an area where paddy-based crop is predominantly grown in Malaysia. The study was conducted within three years being the time frame for the research programme and relied on memory recalled data by the
paddy farmers for its analysis.

19 Organization of the Thesis.

This thesis is arranged in five chapters. Chapter 1 discussed Malaysian paddy production, technology use for paddy production in MADA, and Malaysia. Research problem, objectives and the significant of the study is further discussed in the chapter.

Chapter 2 discussed the definitions, concept and measurement of technological change, related past studies to the research topic and methodological issues related to the study using paddy and other cereals crops for reviewing.

Chapter 3 focused on the conceptual frameworks, data collection, sampling techniques, basic model and analytical techniques used to estimate the objectives in the study.

Chapter 4 stated the results of the study, comprising of descriptive analysis to examine the socio-economic characteristics of paddy farmers in the study area, logit regression analysis to examine the socio-economic factors influencing adoption of HYVs, production function analysis for estimating the effect of new high yielding varieties on paddy yield as well as return to scale, upward shift in production function as a results of adopting new technology, optimum resource used in paddy production was also discussed.

Chapter 5 presents the concluding parts of the research study in line with the objectives and from the research findings. However, policy implication and recommendations are further discussed in the later chapter.
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