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THE TOTAL FACTOR PRODUCTIVITY IN STRATEGIC FOOD CROPS INDUSTRY OF MALAYSIA

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Abstract

Total Factor Productivity (TFP) may indicate the long-term economic growth of a country. In addition, it is also a comprehensive measure of the level of productivity in the economy. Therefore, these study attempts to investigate the TFP for Malaysia paddy sub-sector. The study was conducted in four Muda Agricultural Development Authorities (MADA) regions and employed a seasonal the series of data from 1996 to 2011. Result has found that the actual TFP growth is below than 5 percent for each season. The study also found that the actual TFP trend has been volatile over time. Study has further investigated the factors affecting TFP growth in the Malaysian paddy industry for the entire period. Seven selected factors are found to be associated with striking TFP growth. The result has discovered that all the selected factors are important in influencing the paddy production in Malaysia. However, the magnitude is different for each region.

Keywords: Total factor productivity, paddy, MADA, self-sufficiency level (SSL)

1. INTRODUCTION

Nowadays, the contribution of the Malaysian agricultural sector to economic growth is getting smaller compared to that of 1960s. Although the contribution of this sector declined but it stay played an important role in economic growth. Based on figure 1, we discovered that agricultural sector becomes the third most important engine of the economic growth in Malaysia. One of the main crops in Malaysia agricultural sector is a paddy. Since Malaysia was independent in 1957, until now, the paddy sub-sector plays a crucial role in affecting economic, politics, and social landscape of the country (Mutert & Fairhurst, 2002). In addition, this sector is very important especially in terms of the national food security. Therefore, paddy has become the essential food crop in Malaysia. It is also known as a single strategic crop. Hence, because of the importance of this crop, all efforts have been made by the government to ensure that local paddy production can meet the demand of the country.

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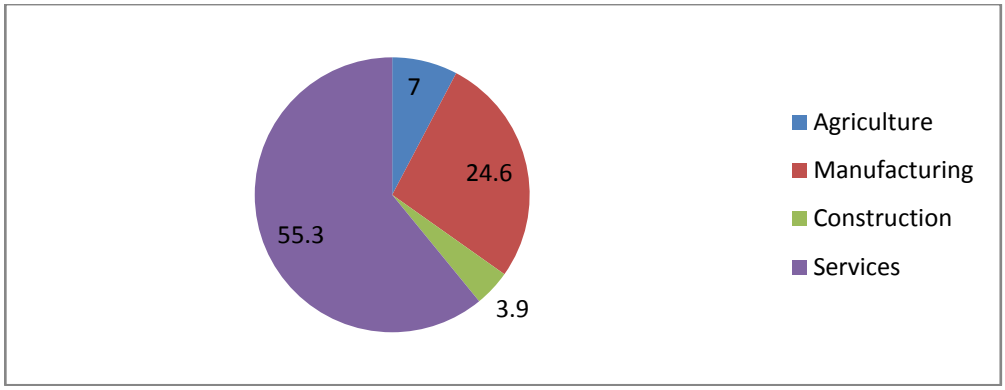

Figure 1: Malaysia gross domestic product by economics sectors in 2014 (%)
Sources: Economic Planning Unit, 2015

However, the competition to be a fully developed country has resulted the paddy sub-sector to face many challenges such as the downsizing of the agricultural land, the dumping of elderly farmers, the migration of young labours to urban areas, poverty, etc. (Najim *et al.*, 2007). These factors in directly cause the reduction in Malaysia's paddy production. Therefore, a new approach to economic growth that is based on Total Factor Productivity (TFP) is necessary to sustain the growth of this sector. In addition, through TFP, the sector can be transformed into a sector that is capable of generating a lucrative source of income for small farmers. TFP growth reflects the increase in the level of productivity as a result of the existence of technical efficiency in the use of production inputs. Most of the time, the efficiency of agricultural inputs arises from the presence of technology and overall economic efficiency. Moreover, TFP is also a measure of the efficiency of labour and capital. The increase in output may occur if the combination of labours and capital inputs is effectively used. The high level of TFP growth in the paddy sector is an important benchmark for improving the farmers' standard of living.

The problem of paddy sub-sector in Malaysia is that the growth of local paddy production is still low. In 2009 to 2010, paddy production growth was only about 1.48 per cent, while the growth of the domestic demand rose by an average 5.2 percent in the same year. Based on these facts, it indicates that the yield of paddy in Malaysia is lower than the national paddy production target at 5 percent annually (FOA, 2002; Othman, 2008; Department of Agriculture, 2011). In 2010, Malaysia has experienced a shortage of production approximately 125,552.15 metric tonnes of paddy. In terms of consumption, Malaysia increased the use of paddy or rice from 2.49 million metric tonnes in 2009 to 2.60 million metric tonnes in 2010 (USDA Foreign Agricultural Service, 2012). To meet the domestic demand, the government had to import paddy or rice from abroad. Malaysia has been importing rice worth about RM1.0 to RM 1.3 million per year, which represents roughly 30 percent of its rice imports.

Therefore, the increase of TFP paddy production is very important, especially to enhance the paddy self-sufficiency level (SSL). This may ensure that paddy stocks are adequate to fulfil the local demand. In addition, the increased levels of TFP have shown the existence of technical efficiency in inputs used. Besides, the increase in TFP levels has also reduced the dependence of import. This will, in turn, increase the small-scaled farmers' income as well as improving their standard of living.

Hence, the first objective of this study is to examine the growth of TFP in the paddy sub-sector in Malaysia. The second objective is to identify the factors that affect the TFP in the paddy sub-sector. For this study, a number of inputs have been selected. Among the variables are average paddy yield, labours, lands, capital, fertiliser, and paddy prices. In general, this paper is divided into five parts. The first part is the introduction. The second part is a literature review related to the TFP.

The third and fourth parts concern about the methodology and results while the last part is the conclusion of the study.

2. LITERATURE REVIEW

The neoclassical concept of TFP has been widely used in agricultural studies until now. There are two main functions of TFP. Firstly, TFP is used to measure the productivity of all factors, and secondly, it is used to associate with the aggregate production function. According to Jesus (2007), TFP is a measure by how output changes and time passes with the input bundle held constant. As in other sectors, TFP is used to measure the performance of the agricultural sector and in the same way, it provides a guide to the efficiency of the sector (Kirsten & Vink, 2003; Thirtle *et al.*, 2005; Conradie *et al*., 2009). Increased productivity shows that there is an element of efficiency in the use of production inputs. This means that there is no wastage of inputs in the production process. Technically, productivity is the ratio between the quantities of output produced on inputs used in a production process. In the meantime, increased productivity also means that the use of the same number of inputs can increase the amount of production. This means that operating costs, especially the cost of production, can be reduced.

Hayami & Ruttan in the 1970s are the earliest group of researchers who have conducted a study on measuring of the productivity level in the agricultural sector. The increase in productivity means that the supply of food and basic materials may increase. This in turn may increase the level of welfare of the society and the state. Hayami and Ruttan have concluded that the productivity growth in the agriculture is essential to the economic growth. Besides Hayami and Ruttan, Stefan (2002) also believed that productivity is one of the basic variables that drive economic activities. In addition, the increased levels of productivity are also related to the creation of value-added products. Basically, the increased productivity means increasing the efficiency of resource used.This may help to decrease the wastage of material resources in production.

According to Katrz (1964) and Rahman (1999), Total Factor Productivity (TFP) occurs from the advance of technology used in the production process. According to them, the advancement in technology may drive the growth of output and labour. Therefore, the use of technology becomes a key determinant for the labour productivity. In addition to technology, capital-labour ratio can also be used as a tool to measure the level of productivity. Meanwhile, the capital-labour ratio can also be used as a variable to represent the level of technology. In general, an increase in the level of technology occurs when the ratio between capital and labour increases. In a study conducted by Hishashi (1991), it is shown that technological advances have a direct relationship with the capital input. If the firm is capital-intensive, it may potentially create the higher levels of productivity compared to labour-intensive firm.

However, the increase in the level of productivity is not affected by the level of technology alone. The quality of the inputs used is also very significant in influencing the productivity growth. If the quality of input increases, the same amount of input can produce more output. Improvement in the quality of input may indirectly reduce the production costs. In addition, there are also other factors affecting the productivity growth such as human resource management, change in socio-demographic, employment and working facilities, human resources and institutional restructuring, socio-economic, and socio-political impact.

Every economic transformation process may involve labour, capital, materials, and energy act as a production input. Basically, the process of transformation can produce more than one output either middle or end product. The agricultural sector is not exempted from this transformation process. This is because every single transformation involves a change in the level of productivity. This shows that the combination of inputs can affect the level of productivity differences. Basically, the change in the level of productivity can be measured by using two approaches such as Partial

Productivity and Total Factor Productivity (TFP). For a single input, productivity notation is (Y / L). This notation should not cause any problems in measuring the productivity level. The ratio of output to input is called Partial Productivity. However, if the combination of various inputs is used in the agricultural production process, then there is the question of how the weight of each input should be used. Therefore, to resolve this issue, the Total Factor Productivity (TFP) is employed.

2.1. Selected variables affecting TFP

There are various factors that can affect the Total Factor Productivity (TFP) in the paddy industry. All these factors have either director indirect relationship with the TFP growth. For this study, there are seven variables that have been selected such as land, capital, young farmers, old farmers, fertiliser, paddy prices, and paddy yield.

2.1.1 Capital

The capital is one of the basic inputs in the production function of neoclassical and is composed of raw materials and intermediate products. In many empirical researches, many researchers have found that capital is important in determining the TFP in the production of paddy (Oniah *et al.*, 2008). In addition, they have also found that the flexibility and return on capital for the agricultural sector is high. High elasticity and return on capital investment show that small changes in capital can lead to a higher TFP growth. This shows that capital has a huge impact on agricultural production. To increase production, farmers need to increase their investment in capital, such as purchasing or leasing a new machine. Meanwhile, Muzaffar (1988) has also stated that capital is an important input in the production of paddy in Malaysia. According to him, investment in agricultural capital is elastic. This means that the increase in paddy production is driven by the capital employed.

2.1.2 Land

There are a number of studies which have found that land and labour are important factors in the production. In addition, there are some researchers such as Sachchamarga & Williams (2004) and Moses & Adebayo (2007) who stated that capital and land are substituted. But this opinion has been refuted by Oniah *et al.* (2008). According to them, this case may be true for a manufacturing sector. It is because they have strongly believed that land is a key input in the agricultural sector, therefore, it is very difficult to be replaced by capital. They also assume that land has a significant impact on the paddy TFP growth. Although land is significant in the agricultural sector, the degree of elasticity is relatively small. This means that land is not a major element of the TFP growth. However, for many researchers, they still do not consider land as part of the agricultural production system. Therefore, it means that if we abide land in our analysis, it will produce biased estimates.

In addition, Suresh & Ready (2006) have found that the ratio of the marginal value product per marginal cost factor of land (MPV / MFC) in India is 3:04. This indicates that an increase in land may create the economies of scale. This in turn may help to increase the more sustainable productivity growth. In another study by Sherlund *et al.* (2002), it has been found that paddy output has a significant relationship with land. This means that, by taking into account the impact of agricultural production and the environmental, an extra one-percent increase in land may increase paddy production by about 80 percent in the Cote d `Ivoire.

2.1.3 Labour

Labour refers to the number of people who are paid to work. It becomes a major tool to increase the output. Basically the wages rate paid to workers are included in the cost of production. In addition, labour also plays an important role in agricultural production. There are a few researchers such as Goni & Baba (2007), Oniah *et al.* (2008), Basavaraja *et al.* (2008), and Chaudhry *et al.* (2009) who have proven that labour is important in the agricultural production. Although labour is an important input, the supply of labour is inelastic. This means that the supply of labour is competitive. If the

non-agricultural sector offers a higher pay, the labour may migrate to manufacturing and services sectors.

Various proxies are used to represent the labour such as family labour, hired labour, child labour, man-days per hectare, and human hours and bullocks have been used. There are also those who use the aggregate labour force data. For those who have employed the time-series data and panel data analysis in empirical estimation, the aggregate labour data may be used due the difficulty to obtain data on details.

2.1.4 Fertiliser

Fertiliser is one of the most important factors in the agricultural production. The precise amount of fertiliser use can help to improve the production. It is categorised in to two types, namely chemical and organic fertilisers. Fertiliserisan additional nutrient supplied to the plants. It is crucial especially to improve the productivity level. The use of fertiliser that complies with the specification may help to increase the soil fertility.The fertility of soil means that the soil contains enough nutrients such as nitrogen, phosphorus, potassium, and others that are important to seedlings growth.The efficient use of fertilisers may help farmers to increase their production up to more than 20 percent.

Heady and Dillon were the earliest researchers who have conducted preliminary investigations on the relationship between fertiliser and output production. Through their research, Heady and Dillon have discovered that fertiliser has a direct nexus with the output. After Heady and Dillon's works, fertiliser-related literatures have become substantial. Subsequently, many researchers have concluded that fertilisers are complementary to the land input. Therefore, to increase paddy production, farmers need to ensure that they comply with proper fertilisation schedule (Suresh & Ready, 2006; Ready, 2007)

2.1.5 Paddy price

Parallel to other sectors, the price of the output is also important in influencing the resources allocation for production (Liyan & Richard, 1993). According to Mundlak (1988), output prices also play an important role in influencing the level of productivity of the agricultural sector.In addition; Mundlak has also stressed the importance of price as a basis in determining the production techniques. When the output price increases, farmers' income also increases. The increase in the income may motivate farmers to produce more output. This indirectly helps to increase the supply of agricultural output. Several studies have demonstrated that price and productivity are related. For instance, Schultz (1979) in his study in the US has indicated that the higher output prices act as a catalyst to increase the productivity in the agricultural sector.

Price plays two major roles; firstly, it reflects the level of consumption especially among the poor. Secondly, the price is also affected the supply through the increased production as an incentive to producers. In fact, there are two distinct desires among consumers and producers. Consumers want low prices, but farmers expect higher prices. In the case of Malaysia, this difference is the offset of the role of the government by providing price subsidies for both consumers and agricultural producers.

2.1.6 Paddy yield

Output is a final product of a production process. In the agricultural sector, output or agricultural products may vary depending on the quality of the inputs used. Output is normally associated with efficiency of a production process. Meanwhile, efficiency is often linked to the performance of a firm as efficiency reflects the ratio between the outputs to the input. In many literatures, the efficiency concept is often associated with productivity because it involves the ratio between the inputs to the output. However, the definition of these two different concepts is varied as

productivity refers to the ratio of the input to the output mean while efficiency involves the ratio between the outputs to the input.

3. METHODOLOGY

This study was to determine the contribution of labour, capital, land, fertiliser and paddy prices to the paddy TFP production in Malaysia. The information obtained is useful for all stakeholders in the paddy production. Below are some assumptions before TFP is measured:

1. The production is constant returns to scale.
2. The input market is a perfect competition. The factors of production are paid according to their marginal product. The elasticity of the output with respect to inputs equals to the value of input shares in the output.

The Total Factor Productivity measurement by using the production function pioneer is a work of a few authors, such as Solow (1957), Dension (1967) and Jorgenson *et al.* (1987). They have assumed that production function is in the transcendental logarithms (translog). The natural logarithmic production function of paddy in Malaysia is as follows:

$$lnY_t = lnA + \beta_1 lnX_{1t} + \beta_2 lnX_{2t} + +\beta_3 lnX_{3t} + \beta_4 lnX_{4t} + \beta_5 lnX_{5t} + \beta_6 lnX_{6t} + \mu_t \quad \text{..... (1)}$$

by total differentiating equation above, we obtain

$$dy_t = d\lambda_t + \frac{\partial Y_t}{\partial X_{1_t}} \cdot \frac{X_{1_t}}{Y_t} dx_{1_t} + \frac{\partial Y_t}{\partial X_{2_t}} \cdot \frac{X_{2_t}}{Y_t} dx_{2_t} + \frac{\partial Y_t}{\partial X_{3_t}} \cdot \frac{X_{3_t}}{Y_t} dx_{3_t} + \frac{\partial Y_t}{\partial X_{4_t}} \cdot \frac{X_{4_t}}{Y_t} dx_{1_t} + \frac{\partial Y_t}{\partial X_{5_t}} \cdot \frac{X_{5_t}}{Y_t} dx_{1_t} + \frac{\partial Y_t}{\partial X_{6_t}} \cdot \frac{X_{1_t}}{Y_t} dx_{6_t} \quad \text{..... (2)}$$

Where $y_t, x_{1_t}, x_{2_t}, x_{3_t}, x_{4_t}, x_{5_t}$ and x_{6_t} are the logarithms for $Y_t, X_{1_t}, X_{2_t}, X_{3_t}, X_{4_t}, X_{5_t}$ and X_{6_t}

$\frac{\partial Y_t}{\partial X_{1_t}} \cdot \frac{X_{1_t}}{Y_t}$ = input share of X_{1_t} in total output
$\frac{\partial Y_t}{\partial X_{2_t}} \cdot \frac{X_{2_t}}{Y_t}$ = input share of X_{2_t} in total output
$\frac{\partial Y_t}{\partial X_{3_t}} \cdot \frac{X_{3_t}}{Y_t}$ = input share of X_{3_t} in total output
$\frac{\partial Y_t}{\partial X_{4_t}} \cdot \frac{X_{4_t}}{Y_t}$ = input share of X_{4_t} in total output
$\frac{\partial Y_t}{\partial X_{5_t}} \cdot \frac{X_{5_t}}{Y_t}$ = input share of X_{5_t} in total output
$\frac{\partial Y_t}{\partial X_{6_t}} \cdot \frac{X_{6_t}}{Y_t}$ = input share of X_{6_t} in total output
dy_t = growth rate of paddy yield = d (log Y)
dx_{1_t} = growth rate of land = d (log X_1)
dx_{2_t} = growth rate of capital = d (log X_2)
dx_{3_t} = growth rate of young farmers = d (log X_3)
dx_{4_t} = growth rate of old farmers= d (log X_4)
dx_{5_t} = growth rate of fertiliser = d (log X_5)
dx_{6_t} = growth rate of paddy price = d (log X_6)
$d\lambda_t = TFPG = d(logA)$

Equation (2) can be rewritten as:

$$TFPG_t = d\lambda_t = dy_t - \frac{\partial Y_t}{\partial X_{1_t}} \cdot \frac{X_{1_t}}{Y_t} dx_{1_t} - \frac{\partial Y_t}{\partial X_{2_t}} \cdot \frac{X_{2_t}}{Y_t} dx_{2_t} - \frac{\partial Y_t}{\partial X_{3_t}} \cdot \frac{X_{3_t}}{Y_t} dx_{3_t} - \frac{\partial Y_t}{\partial X_{4_t}} \cdot \frac{X_{4_t}}{Y_t} dx_{4_t} - \frac{\partial Y_t}{\partial X_{5_t}} \cdot \frac{X_{5t}}{Y_t} dx_{5_t} - \frac{\partial Y_t}{\partial X_{6_t}} \cdot \frac{X_{6_t}}{Y_t} dx_{6_t} \quad \text{..... (3)}$$

The above method is based on a growth accounting framework. Growth in production is due to the two-input growth and productivity growth. Finally, is the unexplained portion of the output growth, which is obtained as the residual of the output. By using Equation (4) and applying it to paddy production, we have

$$dlnQ_t = d\lambda_t + \frac{\partial Y_t}{\partial X_{1_t}} \cdot \frac{X_{1_t}}{Y_t} dx_{1_t} + \frac{\partial Y_t}{\partial X_{2_t}} \cdot \frac{X_{2_t}}{Y_t} dx_{2_t} + \frac{\partial Y_t}{\partial X_{3_t}} \cdot \frac{X_{3_t}}{Y_t} dx_{3_t} + \frac{\partial Y_t}{\partial X_{4_t}} \cdot \frac{X_{4_t}}{Y_t} dx_{4_t} + \frac{\partial Y_t}{\partial X_{5_t}} \cdot \frac{X_{5t}}{Y_t} dx_{5_t} + \frac{\partial Y_t}{\partial X_{6_t}} \cdot \frac{X_{6_t}}{Y_t} dx_{6_t} \quad \text{..... (4)}$$

where Q is paddy yield. $X_{1_t}, X_{2_t}, X_{3_t}, X_{4_t}, X_{5_t}$ and X_{6_t} are inputs (land, capital, young farmers, old farmers, fertiliser, and paddy price). $d\lambda_t$ is TFP growth.

Using a discrete point in time and assumptions are listed above. This implies that the income of each input is the same as the elasticity of their production is stated Therefore, Equation (2) can be summarised as follows (Solow, 1957; Dension, 1967; Jorgenson *et al.*, 1987):

$$TFPgrowth = (lnQ_t - lnQ_{t-1}) - LX_{1_t}(lnX_{1_t} - lnX_{1_{t-1}}) - LX_{2_t}(lnX_{2_t} - lnX_{2_{t-1}}) - LX_{3_t}(lnX_{3_t} - lnX_{3_{t-1}}) - LX_{4_t}(lnX_{4_t} - lnX_{4_{t-1}}) - LX_{5_t}(lnX_{5_t} lnX_{5_{t-1}}) - LX_{6_t}(lnX_{6_t} - lnX_{6_{t-1}}) . \quad \text{..... (5)}$$

Where LX_{1_t} = average share of land = $0.5(LX_{1_t} + LX_{1_{t-1}})$
LX_{2_t} = average share of capital = $0.5(LX_{2_t} + LX_{2_{t-1}})$
LX_{3_t} = average share of young farmers= $0.5(LX_{3_t} + LX_{3_{t-1}})$
LX_{4_t} = average share of old farmers = $0.5(LX_{4_t} + LX_{4_{t-1}})$
LX_{5_t} = average share of fertiliser= $0.5(LX_{5_t} + LX_{5_{t-1}})$
LX_{6_t} = average share of paddy price = $0.5(LX_{6_t} + LX_{6_{t-1}})$

4. RESULTS AND DISCUSSION

The results of the real TFP growth for MADA Regions 1, 2, 3, and 4 are shown in Figure 1. This study has revealed that the real TFP growth is less than 5 percent for every season. This finding is consistent with several studies conducted by Oulton & O'Mahony (1994) and Mao *et al.* (2003). The fluctuation of the real TFP growth is uncertain. There were times where the TFP grew in the main season and decreased in the off-season and vice versa. Based on the observation from Figure 2, the research has discovered that the increase in the real TFP growth was recorded in the main seasons. Meanwhile, the decrease in the real TFP growth often existed in the off-seasons.

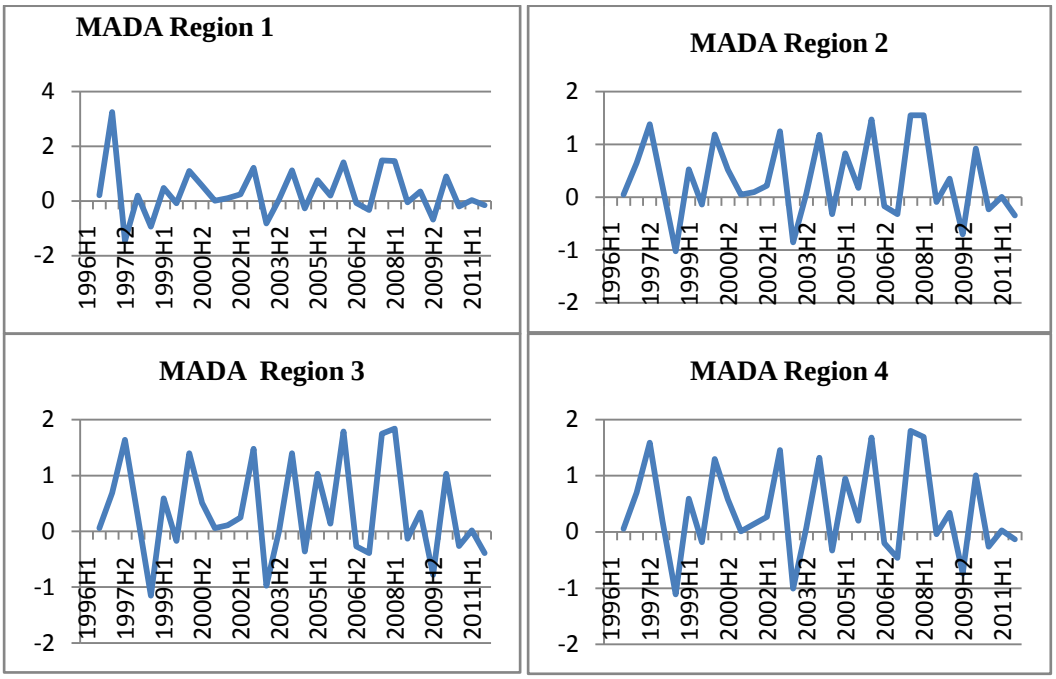

Figure 2: The Real Total Factor Productivity (TFP) Growth of Paddy Production in MADA (%)

Notes: H1 is main-season, H2 is off-season

Table 1 shows the real Total Factor Productivity (TFP) of paddy production in the MADA areas. In Region 1, the average real TFP growth is 0.34 percent per season over the entire period of study. For the short-run, the real TFP average growth is 0.29 percent per season from 1996H2 to 2003H1 and 0.38 percent from 2003H2 to 2011H1. Meanwhile, in Region 2, the average real TFP growth is 0.35 percent. In the short-run, the real TFP average growth is 0.30 percent per season from 1996H2 to 2003H1 and 0.39 percent from 2003H2 to 2011H1.

Furthermore, in Region 3, the average real TFP growth is 0.40 percent per season over the entire period from 1996H1 to 2011H1. For the short-run periods, the real TFP average growth is 0.34 percent per season from 1996H2 to 2003H1 and 0.45 percent from 2003H2 to 2011H1. Meanwhile, in Region 4, the average real TFP growth is 0.39 percent. For the short-run periods, the real TFP average growth is 0.33 percent per season from 1996H2 to 2003H1 and 0.44 percent from 2003H2 to 2011H1.

Table 1: The real total factor productivity growth (TFPG) of paddy production in MADA (%)

Years	Region 1	Region 2	Region 3	Region 4
H11996	-	-	-	-
H21996	0.20	0.05	0.06	0.06
H11997	3.25	0.65	0.69	0.70
H21997	-1.47	1.38	1.64	1.59
H11998	0.19	0.20	0.27	0.19
H21998	-0.94	-1.02	-1.15	-1.11
H11999	0.47	0.53	0.59	0.59
H21999	-0.09	-0.14	-0.17	-0.18
H12000	1.10	1.19	1.40	1.30

H22000	0.56	0.52	0.51	0.58
H12001	0.01	0.05	0.06	0.01
H22001	0.10	0.10	0.11	0.14
H12002	0.24	0.22	0.25	0.27
H22002	1.21	1.25	1.48	1.46
H12003	-0.82	-0.85	-0.97	-1.01
H22003	0.07	0.06	0.02	0.07
H12004	1.12	1.18	1.40	1.32
H22004	-0.27	-0.32	-0.36	-0.33
H12005	0.76	0.83	1.03	0.95
H22005	0.19	0.18	0.14	0.20
H12006	1.41	1.47	1.79	1.68
H22006	-0.08	-0.17	-0.27	-0.20
H12007	-0.33	-0.32	-0.39	-0.46
H22007	1.48	1.55	1.75	1.80
H12008	1.46	1.55	1.84	1.69
H22008	-0.05	-0.09	-0.13	-0.04
H12009	0.35	0.35	0.34	0.34
H22009	-0.68	-0.70	-0.78	-0.74
H12010	0.90	0.92	1.03	1.01
H22010	-0.21	-0.23	-0.26	-0.26
H12011	0.03	0.01	0.02	0.03

Notes: All the values are computed by the researchers

Statistical information in Table 1above is meaningless if we do not know what the real causes are that affect the TFP growth. Therefore, to understand the real causes that affect the growth of the productivity, we have employed the Fabricant's Law (1942). In the Fabricant's Law, there are several connotations of the relationship between productivity and production. Firstly, the Fabricant Law has stated that there is a sign if cant and positive relationship between labour productivity and output growth. Secondly, there is also a significant and positive relationship between the TFP growth and output in the short or long term. Normally, the TFP growth tends to be higher if the output growth is high.

Table 2 shows the correlation coefficients and t-statistic between the TFP growth, output growth, capital growth, labour growth, and the other growth factors such as land, fertiliser, and paddy price. The long-run TFP growth in Regions 2 and 4 is significant and positively correlated with the output growth. It shows that the TFP growths are likely to move together with the output growth. Thus, the cycle of the TFP growth is due to the growth of paddy production, which is heavily influenced by the amount of the current paddy production. However, for MADA Regions 1 and 3, this study has shown that TFP has an insignificant relationship with the paddy yield in the long-run.

Table 2: Total factors productivity growth (TFPG) correlation coefficients

MADA	Period	Δly	Δln	Δlk	Δll40	Δll41	Δlf	Δlp
				Long-run				
	1996H1	-0.22	0.16	0.38*	0.44*	0.49*	0.24	0.2
	-2011H1	(-1.18)	-0.84	-2.2	-2.59	-3.01	-1.32	-1.08
				Short-run				
1	1996H1	-0.31	0.27	-0.05	0.73*	0.72*	0.70*	-0.11
	-2003H1	(-1.17)	-1.01	(-0.17)	-3.81	-3.78	-3.54	(-0.39)
		0.51*	-0.07	0.73*	0.12	0.11	0.23	0.41
	2003H2-	-2.12	(-0.26)	-3.84	-0.42	-0.4	-0.86	-1.61
	2011H1							
2				Long-run				

	1996H1	0.34**	0.2	0.51**	0.19	0.19	0.73**	0.28
	-2011H1	-1.94	-1.08	-3.17	-1.05	-1.03	-5.63	-1.52
				Short-run				
	1996H1	0.005	0.0002	-0.001	0.002	0.002	0.05*	-0.003
	-2003H1	-0.27	-1.29	(-0.32)	-1.16	-1.16	-5.61	(-0.57)
	2003H2-	0.51*	-0.07	0.73*	0.12	0.11	0.23	0.41
	2011H1	-2.12	(-0.26)	-3.84	-0.42	-0.4	-0.86	-1.61
				Long-run				
	1996H1	0.29	0.03	0.53*	0.17	0.18	0.72*	0.29
	-2011H1	-1.63	-0.18	-3.32	-0.93	-0.95	-5.53	-1.57
3				Short-run				
	1996H1	0.11	0.07	-0.09	0.28	0.3	0.85*	-0.14
	-2003H1	-0.38	-0.26	(-0.31)	-1.07	-1.11	-5.71	(-0.49)
	2003H2-	0.41	-0.06	0.75*	0.09	0.09	0.67*	0.42
	2011H1	(1.640	(-0.20)	-4.1	-0.33	-0.32	-3.25	-1.65
				Long-run				
	1996H1	0.41*	0.02	0.52*	0.18	0.17	0.74*	0.26
	-2011H1	-2.37	-0.13	-3.18	-0.95	-0.93	-5.83	-1.42
4				Short-run				
	1996H1	0.27	0.07	-0.1	0.28	0.29	0.85*	-0.16
	-2003H1	-1.01	-0.24	(-0.37)	-1.07	-1.08	-5.75	(-0.60)
	2003H2-	0.55*	-0.08	0.74*	0.1	0.09	0.70*	0.39
	2011H1	-2.39	(-0.30)	-3.96	-0.35	-0.31	-3.58	-1.54

Notes: * 5 percent significant level, values in parentheses are t-statistic

In other findings, there is a significant and positive correlation between TFP and fertiliser in Regions 2, 3, and 4 in the long-run. These findings are consistent with Muhammad & Qazi (2003), Nin-Pratt & Yu (2008), and Khalid & Anthony (2012). However, in Region 1, the long-run co relational study has indicated that there is no significant correlation between TFP and fertiliser. This study has also discovered that TFP and fertiliser have a positive and significant relationship in the short-run in all MADA regions. This study has also found that TFP and fertiliser have no correlation in the short-run for the period of 2003H2 to 2011H1 for both MADA Regions 1 and 2.In the meantime, this study has also found that fertiliser is significant in most of the short- and long-run in all MADA regions. Therefore, based on the findings above, we can conclude that fertiliser plays an important role in the growth of paddy TFP.

On the average, the study has found that young and older farmers have a significant relationship with the TFP in the long-run in Region 1. The short-term significant relationship between TFP and the age of farmers can also be detected in Region 1. This finding has supported the Feyrer's (2002) work, which has shown that the age structure has a significant impact on TFP. The insignificant correlation between TFP and farmers either in the short- or long-run has indicated that the paddy sub-sector has employed unskilled farmers.

Furthermore, this study has also found that there is a significant long-term relationship between TFP and capital.These findings have suggested that capital and TFP have an interdependence relationship, which supports similar findings obtained by Hassan (2002) and Idris (2007). This reinforces the view that the new technology incorporated, for instance, machinery and equipment utilised in MADA regions, is generally high.

5. CONCLUSIONS

This study has been conducted to examine the TFP trend in a paddy sub-sector in Malaysia. Moreover, this study has also attempted to identify the factors that affect the paddy TFP growth.

The study was conducted in four MADA regions and it used time-series data ranging from the main seasons in 1996 to 2011. Generally, this study has discovered that all the selected factors have influenced the TFP in all MADA regions. However, the magnitude varied across the region. On top of that, the research has also found that the real TFP growth is less than 5 percent and it fluctuates over time. The fluctuation of the real TFP growth is uncertain. In the interim, this research has also discovered that the increase in the real TFP growth was recorded in the main seasons. Meanwhile, the decrease in the real TFP growth often exits in off-sessions.

Therefore, to raise the TFP growth in the paddy sub-sector, the government should take a drastic action to overcome the problems that hinder the growth of TFP. Among the actions that can be taken is avoiding of waste of resources and inefficient use of resources. In addition, the government, through authorised agencies, should ensure that farmers are provided with information and the latest technology of paddy cultivation. This is because, through information and technology, farmers are able to increase the level of TFP and, thus, they can increase the paddy production.

Subsequently, the government should ensure that the contribution of TFP increase at a faster rate. Besides, the government should also ensure the financial proficiency in the use of capital among farmers. This is because, in a paddy sub-sector, the witnessed trend is gradually dumping old farmers, which has a relatively slow absorption in agricultural modernisation. Ceteris paribus, if the government makes less capital investment, this will decrease the growth rate of paddy production. This is attributed by the existence of inefficiency elements among farmers. As a long-term strategy for strengthening and establishing the paddy sub-sector, it is very important for Malaysia to shift from the growth under the input stimulus to the productivity-driven one. Productivity growth that is driven by efficiency and information may ensure that the growth in a paddy sub-sector is competitive, dynamic, robust, and resilient. This, in turn, may ensure farmers to receive high income and enable them to flee the poverty problems. In addition, the increase in the paddy production may help Malaysia to achieve 90 percent of rice SSL. This, in turn, may reduce the amount of rice imports.

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